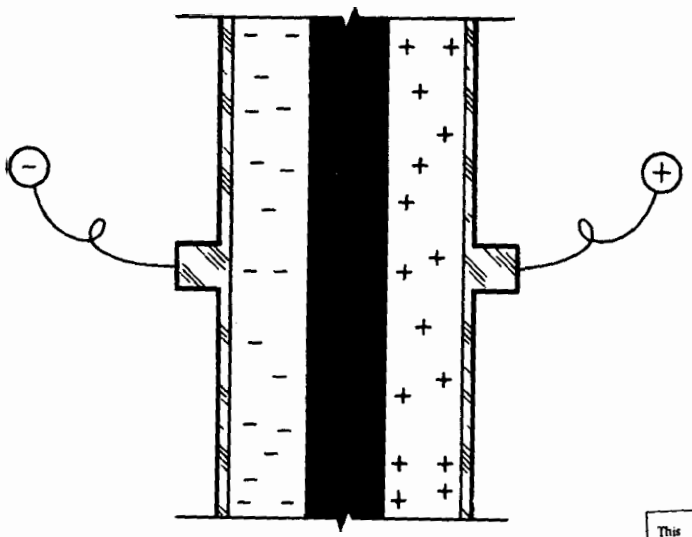
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# Electric Batteries

## A Bibliography



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# INTRODUCTION

One result of the impending shortage of fossil fuels has been increased interest in electric storage batteries. Electricity generation is most efficient when carried out at a constant rate; excess electricity produced during times of low demand would be stored for use during times of peak demand. Electricity produced during low-demand periods could also be used to charge batteries in electric-powered vehicles; the need for petroleum-based fuels is thereby reduced.

To aid individuals and organizations engaged in research on electric batteries, the DOE Technical Information Center (TIC) has cataloged, indexed, and stored in computer-retrievable form a large part of the scientific and technical information published on this subject.

This compilation includes 5422 citations of U. S. and foreign research reports, patents, journal articles, conference proceedings, and books. Current information from these sources is processed into the bibliographic file by TIC on a continuing basis; older information was obtained by retrospective searching of such major secondary announcement publications as *Engineering Index, Government Reports Announcements,* and *Chemical Abstracts.* The citations in this compilation and those continually being added to the file can be recalled by use of the DOE on-line information retrieval system, RECON.

The citations are arranged in broad subject categories, and consist of complete bibliographic citations with abstract; if the abstract of a document is unavailable, the subject descriptors used to describe it for computer storage and retrieval are used in its place.

The Corporate Author Index lists alphabetically the names of organizations and institutions responsible for issuing reports. The entry gives report title, citation number, and report number (where applicable).

The Personal Author Index lists all authors alphabetically—second and succeeding authors are referenced to the first author. Authors' names are followed by the titles of documents and citation numbers.

The Subject Index is an alphabetic listing of the most significant subject descriptors chosen to describe document content. Where pairs of descriptors are entered (separated by a diagonal (/)), the second term indicates the aspect of the first under consideration in the reference. Each entry is followed by document title and citation number.

The Report Number Index is an alphanumeric listing of report numbers. The report numbers are followed by availability statements that include all known information related to the public availability and price of the reports.

Also included in this compilation are energy-related research and development projects currently in progress. Citations to this work are located in a separate section following the main part of the bibliography. These citations are not referenced in the indexes.

An Energy Research in Progress file is being developed at the Technical Information Center in cooperation with the Energy R&D Inventory Project of the Oak Ridge National Laboratory. This file is an inventory of energy-related research, development, and demonstration projects initiated to satisfy requirements of DOE management, the Inventory of Energy Related Research for Congress, and commitments to provide the DOE research projects to the Smithsonian Science Information Exchange. The scope of this file includes all energy sources; generation, transmission, and storage of electric power; energy conservation and utilization; resource exploration, mining, and processing; and economic, environmental, and legal aspects of energy production.

Citations to electric battery information currently in the file may be found on the following pages. Explanations of some of the delimiters appearing there are as follows:

| | |
|---|---|
| (LOCATION) | state where the research is being conducted |
| (SP NAME) | agency or organization sponsoring the research |
| (FUNDING) | for 1976; 1977; 1978 (in thousands of dollars) |
| (CONT OFF) | name of contract officer |
| (CO ADD) | address of contract officer |
| (COOPERAT) | "cooperator"—organization(s) providing time and/or resources toward project but not conducting, supervising, or funding the research |
| (RO TYPE) | type of organization doing the research; e.g., FF = Federally funded R&D center |

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Storage Battery Co., Ltd., Kyoto). 1974.
From 3. international electric vehicle symposium; Washington, District of Columbia, USA (19 Feb 1974).
Proceedings of the third international electric vehicle symposium.
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75 (CONF-740215--P1, pp 21p, Paper 7432) PERFORMANCE OF ZINC CHLORIDE BATTERIES. Symons, P.C. 1974.
From 3. international electric vehicle symposium; Washington, District of Columbia, USA (19 Feb 1974).
Proceedings of the third international electric vehicle symposium.
The requirements for electric storage batteries for urban cars are described. The operation of the zinc chloride battery, as envisaged by Energy Development Associates, is discussed for electric vehicles. The capacity density of the zinc chloride battery is derived and is shown to be independent of discharge rate. The electrochemical performance of the battery is described for various electrode configurations, and the power for various discharge conditions is discussed. The electrode area requirement for an electric urban car is related to the capacity density derived earlier. The auxiliary requirements and safety aspects of zinc chloride batteries in electric vehicles are discussed and their effect on battery energy density is calculated. Finally, the weight of a zinc chloride battery to power an electric urban car is derived. It is shown that the battery will have an energy density of about 70 watt hours/lb and 3 watt hours/in.$^3$ (four hour rate) and a peak power density of about 70 watt/lb. The zinc chloride battery is thus shown to be a powerful contender for electric vehicle traction purposes.

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80 (ERDA--76-136, pp 233-239) SODIUM/SULFUR ADVANCED BATTERIES. Weiner, S. 1976.
From Highway vehicle systems contractors coordination meeting; Ann Arbor, Michigan, USA (4 May 1976).
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The basic elements of a high temperature sodium/sulfur cell are shown, and battery capabilities related to vehicle performance are given. Cell development goals and material costs are summarized.

81 (GEPP--226) SYNTHESIS OF CALCIUM CHROMATE. Dillard, B.M.; Welbon, W.W. (General Electric Co., St. Petersburg, Fla. (USA). Neutron Devices Dept.). 21 May 1976. Contract E(29-2)-656. 21p. Dep. NTIS $3.50.
The laboratory synthesis of calcium chromate suitable for thermal battery use was studied by three synthetic methods: reaction of calcium hydroxide with chromic acid, reaction of freshly slaked lime with chromic acid, and in-situ preparation of ammonium chromate and its reaction with freshly slaked lime. The ammonium chromate-lime reaction was used to prepare a sample for single-cell battery tests and for study of the process at a ten-pound yield level. Equipment necessary for production of calcium chromate by this process on a pilot plant scale is recommended.

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MEETINGS;ENERGY CONVERSION;EFFICIENCY;FUEL CELLS;SOLAR CELLS;ELECTRIC BATTERIES;ENERGY SOURCES;SOLAR ENERGY

88 (N--70-73385) PROCEEDINGS OF THE 18TH ANNUAL POWER SOURCES CONFERENCE; ARMY ELECTRONICS COMMAND, FORT MONMOUTH, NJ. (Army Electronics Command, Fort Monmouth, N.J. (USA)). 1964. 191p. (AD--696423).
From 18. Annual Power Sources Conference; Ft. Monmouth, NJ (19-21 May 1964).
MEETINGS;ELECTRIC GENERATORS;FUEL CELLS; ELECTRIC BATTERIES;ENERGY SOURCES;SOLAR ENERGY; SOLAR CELLS

89 (N--74-70909) ELECTRICAL POWER SYSTEMS STUDY FOR AN INDEPENDENT CARRIER FOR THE APPLICATIONS A AND B EXPERIMENTS. Haines, C.D. (National Aeronautics and Space Administration, Houston, Tex. (USA). Lyndon B. Johnson Space Center). 16 Feb 1968. 95p. (NASA-TM-X--69846). NTIS.
APOLLO PROJECT;SOLAR CELLS;ELECTRIC BATTERIES;ENERGY SOURCES;SPACE FLIGHT;PLANNING

90 (N--75-15152) 1973 GSFC BATTERY WORKSHOP, FIRST DAY. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center). 13 Nov 1973. 193p. (NASA-TM-X--72536). NTIS $7.00.
From GSFC battery workshop; Greenbelt, MD (13 Nov 1973).
ELECTRIC BATTERIES;REVIEWS;MEETINGS;SEALS; BATTERY SEPARATORS;STORAGE;FABRICATION

91 (N--75-16976) GSFC BATTERY WORKSHOP. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center). Nov 1974. 365p. (NASA-TM-X--70822; X--711-74-348). NTIS $10.00.
From Ann. battery workshop; Greenbelt, MD (19--20 Nov 1974).
ELECTRIC BATTERIES;MEETINGS;MARYLAND;TESTING; MATERIALS;NICKEL-HYDROGEN BATTERIES;SPACE VEHICLES

92 (N--75-17808) 1973 GSFC BATTERY WORKSHOP, SECOND DAY. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center). 14 Nov 1973. 162p. (NASA-TM-X--72540). NTIS $6.25.
Ag/$H_2$ cell. ELECTRIC BATTERIES;MEETINGS; TESTING;FABRICATION;MARYLAND;NICKEL-CADMIUM BATTERIES;MATHEMATICAL MODELS;DESIGN; PERFORMANCE;NICKEL-HYDROGEN BATTERIES;SILVER; HYDROGEN;METAL-GAS BATTERIES

93 (N--76-19549) SECONDARY AEROSPACE BATTERIES AND BATTERY MATERIALS: A BIBLIOGRAPHY, 1969--1974. McDermott, P.; Halpert, G.; Ekpanyaskun, S.; Nche, P. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center). Dec 1975. 138p. (NASA-TM-X--71075; X--711-75-316). NTIS $6.00.
Literature in the field of secondary batteries covering a period from 1919 to 1974 is surveyed. Topics covered include electrochemical systems and system components; and techniques and processes used in analytical, thermal, metallurgical, and kinetic studies. An author index, a publication listing of forty journals, and citations and abstracts for the articles in each journal are presented. (auth)

94 (N--77--16437) SECONDARY AEROSPACE BATTERIES AND BATTERY MATERIALS: A BIBLIOGRAPHY, 1969 -- 1974. Mcdermott, P.; Halpert, G.; Ekpanyaskun, S.; Nche, P. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center). Jul 1976. 161p. (NASA-SP--7044). NTIS PC A08.
This annotated bibliography on the subject of secondary aerospace battery materials and related physical and electrochemical processes was compiled from references to journal articles published between 1969 and 1974. A total of 332 citations are arranged in chronological order under journal titles. Indices by system and component, techniques and processes, and author are included.

95 (NASA-SP--54, pp 85-113) ELECTRIC POWER GENERATION. Sanders, N.D.; Morris, J.F.; Nichols, L.D.; Potter, A.E., Jr.; Schwartz, H.J.; Stewart, W.L. 5 Jun 1964.
SPACECRAFT POWER SUPPLIES;REVIEWS;ELECTRIC BATTERIES;SOLAR CELLS;THERMOELECTRIC GENERATORS; FUEL CELLS;GAS TURBINES;MHD GENERATORS; THERMIONIC CONVERTERS

96 (NASA-SP--5015, pp 65-89) ELECTRIC POWER GENERATION. Sanders, N.D.; Morris, J.F.; Nichols, L.D.; Potter, A.E., Jr.; Schwartz, H.J.; Stewart, W.L. (NASA, Lewis Research Center, Cleveland). 1964.
Conference on New Technology, Lewis Research Center, Cleveland, Ohio, June 4-5, 1964.
ENERGY CONVERSION;DIRECT ENERGY CONVERSION;

ELECTRIC POWER;REVIEWS;ELECTRIC BATTERIES;SOLAR CELLS;THERMOELECTRIC GENERATORS;FUEL CELLS; TURBINES;MHD GENERATORS;THERMIONIC CONVERTERS

97 (NASA-SP--5057, pp 281-303) DIRECT ENERGY CONVERSION. Schwartz, H.J.; Ward, J.J. CONVERSION;DIRECT ENERGY CONVERSION; ELECTRICITY;POWER;RESEARCH PROGRAMS;FUEL CELLS; ELECTROCHEMISTRY;ELECTRIC BATTERIES; MAGNETOHYDRODYNAMICS;MHD GENERATORS;THERMIONIC CONVERTERS;THERMOELECTRIC GENERATORS

98 (NP--11716) LIGHTWEIGHT, EXTREMELY HIGH-POWER ELECTRICAL SOURCES. DeMoulin, D.A.; Granger, J.H. (Army Signal Missile Support Agency, White Sands Missile Range, N.Mex. (USA)). 5 May 1962. 33p. (MEWD--1129). ELECTRIC POWER;POWER GENERATION;REVIEWS; ELECTRIC BATTERIES;ELECTRIC GENERATORS; THERMIONIC CONVERTERS;THERMOELECTRIC GENERATORS; MHD GENERATORS;FUEL CELLS;ELECTROSTATICS;SIZE; WEIGHT;TURBINES

99 (NP--13277) DIRECT ENERGY CONVERSION LITERATURE ABSTRACTS. (Naval Research Lab., Washington, D.C. (USA)). Jul 1963. 178p. 1076 references. DIRECT ENERGY CONVERSION; BIBLIOGRAPHIES;THERMOELECTRIC GENERATORS;MHD GENERATORS;ENERGY STORAGE;ELECTROCHEMICAL CELLS

100 (NP--20354) EMISSION OPTIMIZATION OF HEAT ENGINE/ELECTRIC VEHICLE. Andon, J.; Barpal, I.R. (Minicars, Inc., Golsta, Calif. (USA)). 28 Jan 1971. vp. AUTOMOBILES;INTERNAL COMBUSTION ENGINES; ELECTRIC MOTORS;EXHAUST GASES;AUTOMOTIVE FUELS; MIXING;ELECTRIC BATTERIES;ELECTRIC GENERATORS; ELECTRIC-POWERED VEHICLES;HYBRID ELECTRIC-POWERED VEHICLES

101 (NTIS/PS--75/445) NICKEL CADMIUM BATTERIES (A BIBLIOGRAPHY WITH ABSTRACTS). PERIOD COVERED: 1970--MARCH 1975. Smith, M.F. (National Technical Information Service, Springfield, Va. (USA)). May 1975. 19p. NTIS $25.00. NICKEL-CADMIUM BATTERIES;DESIGN;FABRICATION; TESTING;SPACE VEHICLES;BIBLIOGRAPHIES

102 (NTIS/PS--75/471) LITHIUM BATTERIES (A BIBLIOGRAPHY WITH ABSTRACTS). PERIOD COVERED: 1964--JUNE 1975. Smith, M.F. (National Technical Information Service, Springfield, Va. (USA)). Jun 1975. 252p. NTIS $25.00. LITHIUM-CHLORINE BATTERIES;LITHIUM-SULFUR BATTERIES;LITHIUM;ELECTRIC BATTERIES; BIBLIOGRAPHIES;FABRICATION;ELECTROCHEMISTRY; TESTING;ELECTROLYTES;CORROSION;ELECTRIC-POWERED VEHICLES;OFF-PEAK ENERGY STORAGE

103 (NTIS/PS--75/472) LEAD BATTERIES (A BIBLIOGRPHY WITH ABSTRACTS). PERIOD COVERED: 1964--MAY 1975. Smith, M.F. (National Technical Information Service, Springfield, Va. (USA)). Jun 1975. 119p. NTIS $25.00. LEAD-ACID BATTERIES;BIBLIOGRAPHIES; FABRICATION;ELECTROCHEMISTRY;TESTING;SPACE VEHICLES;ELECTRIC-POWERED VEHICLES

104 (NTIS/PS--75/644) ELECTROCHEMICAL REACTIONS AT SURFACES (A BIBLIOGRAPHY WITH ABSTRACTS). REPORT FOR 1964--JUL 1975. Lehmann, E.J. (National Technical Information Service, Springfield, Va. (USA)). Aug 1975. 164p. NTIS $25.00. The studies cover electrode processes in aqueous solutions although some molten salt processss are included. The research covers battery electrode reactions, catalyst reactions, electrochemical corrosion studies, theoretical analysis, fuel cell electrode reactions, electrical double layer, chemisorption, and measurement techniques. (Contains 159 abstracts) (GRA)

105 (NTIS/PS--75/649) SILVER CELLS. A BIBLIOGRAPHY WITH ABSTRACTS. SEARCH PERIOD COVERED: 1964--AUGUST 1975. Smith, M.F. (National Technical Information Service, Springfield, Va. (USA)). Aug 1975. 223p. NTIS $25.00. Research is presented on silver cell primary and storage batteries with respect to electrochemistry, separators, hermetic seals, electrolytes, electrodes, charging, reliability, and applications. Studies concerning silver--zinc cells and silver--cadmium cells are discussed in the majority of these abstracts. (Contains 172 abstrcts) (auth)

106 (NTIS/PS--76/0542) LITHIUM BATTERIES. VOL. I. 1964--1974 (CITATIONS FROM THE NTIS DATA BASE). REPORT FOR 1964--1974. Smith, M.F. (National Technical Information Service, Springfield, Va. (USA)). Jul 1976. 180p. NTIS (US Sales Only). See also NTIS/PS-76/0544.. Topics include the development, fabrication, chemistry, and testing of lithium reserve, high energy, thermal, and storage batteries. Research covers component fabrication, organic electrolytes, molten salt electrolytes, electrochemistry, and corrosion. Batteries designed for electric vehicles, forklift trucks, transceivers and electric utility off-peak energy storage are included. (This updated bibliography contains 175 abstracts, none of which are new entries to the previous edition.) (GRA)

107 (NTIS/PS--76/0543) LITHIUM BATTERIES. VOL. II. 1975--MAY 1976 (CITATIONS FROM THE NTIS DATA BASE). REPORT FOR 1975--MAY 1976. Smith, M.F. (National Technical Information Service, Springfield, Va. (USA)). Jul 1976. 79p. NTIS (US Sales Only). Supersedes NTIS/PS--75/471. See also NTIS/PS--76/0544. Federally- funded research on design, development, components, testing, corrosion, electrolytes, sealing and hazards of lithium cells are presented. Batteries studied include lithium organic cells, lithium--sulfur cells, lithium--thionyl chloride cells, lithium--chlorine cells, lithium--water cells, and lithium--water--air cells. Applications cover use in spacecraft, electric vehicles, off peak energy storage and forklift trucks. (This updated bibliography contains 74 abstracts, 51 of which are new entries to the previous edition.) See also NTIS/PS-76/0542, Lithium Batteries. Vol. 1. 1964--1974. (GRA)

108 (NTIS/PS--76/0544) LITHIUM BATTERIES (CITATIONS FROM THE ENGINEERING INDEX DATA BASE). REPORT FOR 1970--MAY 1976. Smith, M.F. (National Technical Information Service, Springfield, Va. (USA)). Jul 1976. 120p. NTIS (US Sales Only). See also NTIS/PS--76/0542, NTIS/PS--76/0543. Studies on design, development, components, corrosion and hazards are included in this compilation of worldwide research. Lithium batteries with sulfides, chlorine, thionyl chloride, organic compounds and water are cited. Applications cover use of lithium cells

in pacemakers, spacecraft, electric vehicles and off-peak energy storage is discussed. (Contains 115 abstracts) (GRA)

109 (NTIS/PS--76/0549) LEAD BATTERIES (CITATIONS FROM THE NTIS DATA BASE). REPORT FOR 1964--MAY 1976. Smith, M.F. (National Technical Information Service, Springfield, Va. (USA)). Jul 1976. 79p. NTIS (US Sales Only).
Supersedes NTIS/PS--75/472. See also NTIS/PS--76/0550.
The design, development, fabrication, chemistry, and testing of lead batteries are cited in this compilation of Federally- funded research. Specific applications for spacecraft, consumer applications, and electric vehicles are covered. Studies on lead recovery from battery scrap are also included. (This updated bibliography contains 74 abstracts, 12 of which are new entries to the previous edition.) (GRA)

110 (NTIS/PS--76/0550) LEAD BATTERIES (CITATIONS FROM THE ENGINEERING INDEX DATA BASE). REPORT FOR 1970--MAY 1976. Smith, M.F. (National Technical Information Service, Springfield, Va. (USA)). Jul 1976. 183p. NTIS (US Sales Only).
See also NTIS/PS--76/0549.
Worldwide research on lead battery components, charging, corrosion and testing is cited. The majority of studies concern battery use in electric vehicles. Studies on lead recovery from battery scrap and air pollution at battery factories are also included. (Contains 178 abstracts) (GRA)

111 (NTIS/PS--76/0879) SILVER CELLS (CITATIONS FROM THE NTIS DATA BASE). REPORT FOR 1964-SEP 76. Smith, M.F. (National Technical Information Service, Springfield, Va. (USA)). Nov 1976. 203p. NTIS $25.00.
Supersedes NTIS/PS--75/649. See also NTIS/PS--76/0880.
Citations of Federally funded research are presented on silver cell primary and storage batteries with respect to electrochemistry, separators, hermetic seals, electrolytes, electrodes, charging, reliability, and applications. Studies concerning silver/zinc cells and silver/cadmium cells are discussed in the majority of these abstracts. (This updated bibliography contains 198 abstracts, 26 of which are new entries to the previous edition.) (GRA)

112 (NTIS/PS--76/0880) SILVER CELLS (CITATIONS FROM THE ENGINEERING INDEX DATA BASE). REPORT FOR 1970-SEP 76. Smith, M.F. (National Technical Information Service, Springfield, Va. (USA)). Nov 1976. 97p. NTIS $25.00.
See also NTIS/PS--76/0879.
Citations of worldwide research on silver cell primary, storage, and solid state batteries are included in this compilation. Studies on electrochemistry, electrodes, electrolytes, separators, reliability, charging and performance are covered. The use of these batteries in spacecraft, electric automobiles, and submersibles are reported. (Contains 90 abstracts) (GRA)

113 (NTIS/PS--76/0941) MAGNESIUM BATTERIES (CITATIONS FROM THE NTIS DATA BASE). REPORT FOR 1964--SEP 1976. Smith, M.F. (National Technical Information Service, Springfield, Va. (USA)). Nov 1976. 118p. NTIS, PC N01/MF N01.
See also NTIS/PS--76/0942.
Studies on seawater batteries, dry tape batteries, storage batteries, primary batteries, and reserve batteries are cited. Design, development, electrochemistry, components, reliability, and testing are covered in this compilation of Federally-funded research. (Contains 113 abstracts) (GRA)

114 (NTIS/PS--76/0942) MAGNESIUM BATTERIES (CITATIONS FROM THE ENGINEERING INDEX DATA BASE). REPORT FOR 1970--SEP 1976. Smith, M.F. (National Technical Information Service, Springfield, Va. (USA)). Nov 1976. 48p. NTIS, PC N01/MF N01.
See also NTIS/PS--76/0941.
Citations of worldwide research on magnesium battery development, performance, and electrochemistry are included in this bibliography. The majority of studies concern seawater batteries, biomedical implants, and thermal batteries. (Contains 41 abstracts) (GRA)

115 (NTIS/PS--77/0555) NICKEL CADMIUM BATTERIES (A BIBLIOGRAPHY WITH ABSTRACTS). REPORT FOR 1970-JUL 77. Smith, M.F. (National Technical Information Service, Springfield, Va. (USA)). Jul 1977. 263p. NTIS PC N01/MF N01.
The design, fabrication, components, testing, and assembly of nickel cadmium batteries is covered in the bibliography. The majority of these citations deal with the development of power supplies for aircraft and spacecraft. (This updated bibliography contains 258 abstracts, 49 of which are new entries to the previous edition.)

116 (NTIS/PS--77/0637) ELECTRIC AUTOMOBILES. VOLUME 2. 1975--JULY 1977 (CITATIONS FROM THE ENGINEERING INDEX DATA BASE). REPORT FOR 1975--JUL 77. Hundemann, A.S. (National Technical Information Service, Springfield, Va. (USA)). Aug 1977. 170p. NTIS PC N01/MF N01.
Citations from worldwide research cover the design of electric automobiles, vans, buses, and hybrid vehicles. Studies are included on lead-acid, zinc-air, lithium-sulfur, and nickel-cadmium batteries; fuel cells; drive trains; and chassis construction. (The updated bibliography contains 163 abstracts, 70 of which are new entries to the previous edition.) See also NTIS/PS-77/0636, Electric Automobiles. Vol. 1. 1970-1974.

117 (NTIS/PS--77/0638) LITHIUM BATTERIES. VOLUME 2. 1975--JULY 1977 (CITATIONS FROM THE NTIS DATA BASE). REPORT FOR 1975--JUL 77. Smith, M.F. (National Technical Information Service, Springfield, Va. (USA)). Aug 1977. 168p. NTIS PC N01/MF N01.
Federally funded research on design, development, components, testing, corrosion, electrolytes, sealing and hazards of lithium cells are presented. Batteries studied include lithium organic cells, lithium sulfur cells, lithium-water-air cells and lithium nickel fluoride cells. Applications cover use in spacecraft, electric vehicles, off peak energy storage, and forklift trucks. (This updated bibliography contains 163 abstracts, 89 of which are new entries to the previous edition.)

118 (NTIS/PS--77/0639) LITHIUM BATTERIES (CITATIONS FROM THE ENGINEERING INDEX DATA BASE). REPORT FOR 1970. Smith, M.F. (National Technical Information Service,

Springfield, Va. (USA)). Aug 1977. 159p. NTIS PC N01/MF N01.
Studies on design, development, components, corrosion and hazards are included in this compilation of worldwide research. Lithium batteries with sulfides, chlorine, thionyl chloride, organic compounds and water are cited. Applications cover use of lithium cells in pacemakers, spacecraft, electric vehicles, and off peak energy storage. (This updated bibliography contains 152 abstracts, 37 of which are new entries to the previous edition.)

119 (PB--240132) ENERGY WORKSHOP ON ELECTROCHEMISTRY. A REPORT ON DISCUSSION OF ENERGY-RELATED BASIC RESEARCH IN ELECTROCHEMISTRY, JUNE 27--28, 1974. FINAL REPORT. Osteryoung, R.A.; Murray, R.W. (North Carolina Univ., Chapel Hill (USA)). Sep 1974. 56p. (UNC--100). NTIS $4.25.
ELECTROCHEMISTRY;MEETINGS;ELECTRIC BATTERIES; FUEL CELLS;CORROSION;ELECTROLYSIS;CHEMICAL REACTION KINETICS;ELECTRODES;PHOTOVOLTAIC CELLS; SURFACES

120 (PB--251490, pp 75-90) LEAD--ACID STORAGE BATTERIES FOR LOAD LEVELING. Cook, A.R. (International Lead-Zinc Research Organization, New York). Mar 1976.
Near-term energy storage technologies: workshop on lead--acid batteries, Palo Alto, California, November 18--19, 1975.
This paper provides electrical engineers in the utility industry with an insight into the technology of the lead--acid battery in order to give background for understanding of designs for the optimum lead--acid battery for load leveling and peak power shaving. 5 figures

121 (UCRL--50038-76-2) RESEARCH LEADING TO THE PRODUCTION AND EARLY USE OF NUMERIC DATA BANKS OF MATERIAL PROPERTIES AND SYSTEM ANALYSES. SECOND QUARTERLY PROGRESS REPORT, APRIL--JUNE 1976. Henry, E.A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 16 Sep 1976. Contract W-7405-ENG-48. 31p. Dep. NTIS $4.00.
This report describes the progress leading to the creation of data bases for energy storage. The following data requests were sent to NBS: 9 properties of 25 metal alloys considered for flywheel rotors; 16 properties of 26 molten salts used for research in high-temperature storage batteries; and 9 properties of 2 solid electrolytes also under development for high-temperature storage batteries. A bibliographic data base for flywheel energy-storage systems was created. Work was continued on the systems structure for the energy-storage data bases. A test of this prototype data-base structure was begun for data on properties of salts used in thermal storage systems. Preliminary definitions were developed for data bases to permit the analysis and intercomparison of energy-storage systems. (DLC)

122 (X--711-77-28) 1976 GODDARD SPACE FLIGHT CENTER BATTERY WORKSHOP. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center). Nov 1976. 368p. (CONF-761178--). Goddard Space Flight Center, Greenbelt, MD.
From 9. annual battery workshop; Greenbelt, Maryland, USA (9 Nov 1976).
A separate abstract was written for each of the 31 papers presented at the workshop. (RWR)

123 COMPUTER SIMULATION OF AUTOMOBILE USE PATTERNS FOR DEFINING BATTERY REQUIREMENTS FOR ELECTRIC CARS. Schwartz, H.J. (NASA-Lewis Res Cent, Cleveland, Ohio). IEEE Trans. Veh. Technol.; VT-26: No. 2, 118-122(May 1977).
A Monte Carlo simulation process was used to develop the United States daily range requirements for an electric vehicle from probability distributions of trip lengths and frequencies and average annual mileage data. The analysis shows that a car in the United States with a practical daily range of 82 mi (132 km) can meet the needs of the owner on 95% of the days of the year, or at all times other than his long vacation trips. Increasing the range of the vehicle beyond this point will not make it more useful to the owner because it will still not provide intercity transportation. A daily range of 82 mi can be provided by an intermediate battery technology level characterized by an energy density of 30 to 50 Wh/lb (66 to 110 Wh/kg). Candidate batteries in this class are nickel-zinc, nickel-iron, and iron-air. The implication of these results for the research goals of far-term battery systems suggests a shift in emphasis toward lower cost and greater life and away from high energy density. In addition, if the implementation of electric vehicles follows the ''S-shaped diffusion model typical of new technologies, the optimum strategy from the standpoint of saving petroleum is to introduce near-term, intermediate, and far-term battery technologies in vehicles at the earliest date at which each battery system can be developed to the point of commercialization.

124 STORING ELECTRICITY. Whitaker, R. Environment; 19: No. 2, 16-39(Mar 1977).
The concept of load leveling, using storage batteries to even out demands on electrical supplies, conserving oil and gas, is discussed. Included are aspects of fuel conservation, efficiency, feasibility, environmental problems, research and development costs, and primary and operating costs. Several types of batteries are described and compared. (CAJ)

125 BATTERY DEVELOPMENT MAKES GOOD PROGRESS. Chem. Eng. News; 55: No. 8, 28-30(21 Feb 1977).
Several advanced batteries capable of high energy storage are under development to supplant conventional lead-acid batteries. ERDA contractors report that, although an improved battery will be ready for 2500 electric cars this year, a more advanced battery will come later. Improvements include minor changes, increased storage capacity by as much as six times, and the use of molten salts as electrodes or electrolytes. In addition to vehicle use, ERDA anticipates a market among electric power utilities for load leveling. Further uses will emerge as solar and wind generators are developed and need storage capacity. The ERDA budget for this program is projected at $16 million for 1978. Near-term work is focused on the electric vehicle, with eight companies working on lead-acid, nickel-zinc, and nickel-iron batteries. Test vehicles are being operated by the Postal Service. Research is aimed at making batteries lighter while retaining their capacity, raising the specific energy, and lengthening the life cycle. Most of the ERDA support for advanced research is going toward lithium-sulfur and sodium-sulfur batteries. Zinc-chloride batteries may be ready for this year's demonstration vehicles. (DCK)

126 BASIC REQUIREMENTS FOR CHARGING EQUIPMENT FOR ELECTRIC ROAD VEHICLES AS SEEN BY THE

UTILITIES WITH SPECIAL EMPHASIS ON HARMONICS. Hotopp, R. (Rheinisch-Westfaelisches Elektrizitaetswerk A.G., Essen (Germany, F.R.)); Klein, F. (GES Gesellschaft fuer Elektrischen Strassenverkehr m.b.H., Duesseldorf (Germany, F.R.)). Elektrotech. Z., A; 98: No. 1, 82-88(Jan 1977). (In German).

The conditions under which an economical energy supply for electric road vehicles is possible is discussed. The generating of harmonics and their reactions on other power consuming and system operating equipment are described. Finally, measures for reducing the level of harmonics are discussed.

127 APPLICATION OF THE FORD SODIUM--SULFUR BATTERY IN ELECTRIC VEHICLES. Unnewehr, L.E.; Minck, R.W.; Owens, C. Warrendale, PA; Society of Automotive Engineers (1977). 9p. (CONF-770205--63).

From Conference of the SAE International Automotive Engineering Congress and Exposition; Detroit, Michigan, USA (28 Feb 1977).

The Ford Sodium--Sulfur battery is evaluated for applications in electric vehicles. The required power and energy ratings of a battery to achieve acceptable performance and driving range for a specific commuter-type vehicle are calculated and discussed. The relative merits of the use of mechanical transmissions and regenerative braking in electric vehicles are explored. Volumes and weights of several battery packages based upon realistic NaS cell designs are calculated, and the thermal management problems of these high-temperature battery packages during the varying power levels required in vehicular applications are discussed.

128 ELECTROCHEMICAL SOCIETY SPRING MEETING. EXTENDED ABSTRACTS. Princeton, NJ; Electrochemical Society (1977). 1027p. (CONF-770531--(Absts.)).

From Meeting of the Electrochemical Society; Philadelphia, Pennsylvania, USA (8 May 1977).

''Extended abstracts'' for the Spring Meeting of the Electrochemical Society in Philadelphia, Pennsylvania, May 8--13, 1977, are presented for the following divisions: Battery, Corrosion, Dielectrics and Insulation, Electronics, Electrothermics and Metallurgy, Energy Technology Group, Industrial Electrolytic, Organic and Biological Electrochemistry, and Physical Electrochemistry. (RWR)

129 ELECTRIC VEHICLES: NEXT MAJOR APPLIANCE AND LOAD MANAGEMENT TOOL. Electr. Light Power (Boston); 54: No. 11, 22-23(Nov 1976).

At the Fourth International Electric Vehicle Symposium in Dusseldorf, Germany, Mr. E.A. Campbell of the U.S. postulated an interesting scenario that showed 25 million electric vehicles in service by the end of the century could: be an ideal load management tool, be easily accommodated by the nation's electric companies, and would greatly cut our use of petroleum as a fuel for transportation. It's Campbell's contention that we cannot easily and economically develop a mass-transit system that would take care of all our needs, so we must keep the alternative--the family car--but change its fuel from gasoline to electric batteries. He said, ''If we start now and plan well, we can have 25 million such vehicles on the road by the year 2000. These cars would demand less than two percent of the expected total power generated in the U.S. at that time.'' Campbell further stated that the practical way to recharge the batteries would be at home, which would make the family car in essence another major appliance.

130 ENERGY. Washington, D.C.; National Aeronautics and Space Administration (Oct 1976). 272p.

This bibliography lists 602 reports, articles and other documents introduced into the NASA scientific and technical information system from July 1, 1976 through September 30, 1976. The coverage includes regional, national and international energy systems; research and development on fuels and other sources of energy; energy conversion, transport, transmission, distribution and storage, with special emphasis on use of hydrogen and of solar energy. Also included are methods of locating or using new energy resources. Of special interest is energy for heating, lighting, for powering aircraft, surface vehicles, or other machinery. Five indexes--subject, personal author, corporate source, contract number, and report number--are included.

131 BATTERIES: TODAY AND TOMORROW. Mennie, D. IEEE Spectrum; 13: No. 3, 36-41(Mar 1976).

The primary battery improvements involve the common alkaline battery varieties containing manganese dioxide and mercuric oxide (separately or in combination). Others include the zinc-air battery developed by Gould and now undergoing field tests with consumers, and the extremely high energy density lithium battery now available. Two completely different approaches being exploited to produce a finished battery are described. The method championed by Mallory Battery Co., Tarrytown, N.Y., and by Power Conversion Inc., Mount Vernon, N.Y., utilizes a lithium anode, organic electrolyte, and proprietary cathode material. Finished batteries produced in this manner contain some sulfur dioxide gas, of which trace amounts are vented during use. Mallory is also developing a hermetically sealed lithium cell intended for consumer use. The Japanese-based Matsushita company has concentrated on producing lithium cells using carbon monofluoride as the cathode. Appliances requiring more current (tape players, cordless tools, etc.) have benefited from secondary systems based on nickel-cadmium and sealed lead-acid cells. A large portion of future secondary battery development involves high-temperature batteries, most notably, sodium-sulfur, sodium-antimony chloride, and lithium-iron sulfide. Evaluating these systems involves tradeoffs between energy density, cycle life, materials/manufacturing cost, and charging methods. The status report on research and monitoring being performed by EPRI, ERDA, and NSF is summarized. (MCW)

132 POWER: PROBLEMS AND PROGRESS. Friedlander, G.D. IEEE Spectrum; 13: No. 1, 64-7(Jan 1976).

POWER TRANSMISSION;POWER GENERATION;UHV AC SYSTEMS;UNDERGROUND POWER TRANSMISSION; CONSTRUCTION;LMFBR TYPE REACTORS;ENVIRONMENTAL EFFECTS;HVDC SYSTEMS;ECONOMICS;COMPARATIVE EVALUATIONS;POWER TRANSMISSION LINES;ENERGY STORAGE;REVIEWS;ALASKA PIPELINE;GAS TURBINES; ENERGY CONVERSION;OFF-PEAK ENERGY STORAGE; EFFICIENCY;COMPRESSED AIR;DIELECTRIC MATERIALS; ELECTRIC POWER;NUCLEAR POWER;PLANNING

133 ELECTROLYTIC AND ELECTRONIC PROCESSES. Taylor, G.B.; Bird, E.F.; Perez, R. pp 595-619 of Efficient electricity use: a practical handbook for an energy constrained world.

Smith, C.B. (ed.). Elmsford, NY; Pergamon Press Inc. (1976).

The use of electrochemical processes such as electrosynthesis, electrowinning, electrochemical recycling, and electrochemical matching should be considered as alternatives to conventional processes where improved efficiency is possible. Further development of fuel cells and electrochemical storage technology is needed in order to produce the high efficiencies necessary for their successful application to energy production on a large scale. Direct energy conversion with fuel cells could play an important role in future electricity production. With improvements in ion conduction, electrocatalysis, and oxygen reduction, for example, each residence or business could produce electricity on demand, using fuels ranging from coal gas to hydrogen with greater efficiency. Production of more-efficient batteries for electrochemical storage of electrical energy will serve to provide two greatly needed capabilities: use of electrical power for transportation and off-peak storage of electricity produced by solar and nuclear generation plants. Basic research and development of electrode mechanisms, materials, configuration, and charging control is needed. The use of hydrogen produced by high temperature electrolysis of steam to be used in both fuel cells and energy storage must be investigated. Corrosion damage to parts, equipment, vehicles, and structures accounts for approximately 1 percent of the United States GNP. It is corrosion that creates loss in fuel cells and batteries and limits the life of these systems. Basic research in corrosion prevention will play an important part in preserving natural resources and energy reserves.

134 VEHICLES USING STORED ELECTRIC ENERGY. REQUIREMENTS AND POSSIBILITIES OF APPLICATIONS. Kahlen, H. BBC-Nachr.; No. 9, 387(1976). (In German).

1 fig. Short communication only.

ELECTRIC-POWERED VEHICLES;ELECTRIC BATTERIES; FUEL CELLS;USES;SYSTEMS ANALYSIS

135 COMPARING INVESTIGATIONS ON POWER SYSTEMS FOR ELECTRIC ROAD VEHICLES. Kahlen, H.; Runge, W.; Weigel, W.D. ISU Mitt.; No. 5, 2-13(1976). (In German).

10 refs..

As an introduction environmental pollution due to vehicles powered with internal combustion engines is analyzed. By way of comparison, the advantages of electric-powered systems are set out. After a general outline on the development of electric-powered vehicles, the claims for vehicles of this kind are dealt with. The institute for converter technology and electric-powered systems at RWTH in Aachen is developing in its research programme a model electric-powered vehicle. Present results are discussed.

136 POWER UNITS USED IN AN IMPLANTED ARTIFICIAL HEART AND AUXILIARY CIRCULATION SYSTEMS. Kiselev, Yu.M.; Kremnev, V.A.; Sadov, V.V.; Spiridonov, V.A. (Inst of Organ and Tissue Transplant, Minist of Health of the USSR, Moscow). Biomed. Eng. (USSR) (Engl. Transl.); 10: No. 4, 241-245(1976).

Self-contained power units presently use exclusively the energy of the decay of Pu$sup 238$ which must be converted before using in the devices. The power unit consists of an isotopic heat source (power source), thermoelectric converter converting the heat energy into electrical energy, storage battery, control and monitoring system, cooling system, and drive system (the main parts of the last are the linear electric motor and bellows pump of the working fluid), vacuum-foil type heat insulation surrounding the isotope capsule and hot parts of the source of the thermoelectromotive-force source, and other auxiliary components. With a mechanical drive, ordinary rotary motors instead of linear ones are used, and such drives characteristically include an accumulator of mechanical energy, which serves a flywheel located in the casing of the blood pump. Some artificial hearts (AH) use piezoelectric transducers in the drive systems to provide reciprocating motion; the rest of the system is analogus to that of the linear-motor system first described. An example of AH using hydraulic drive is also described, and the possibilities and limitations of using heat engines (Rankine or Sterling) are discussed. 4 refs.

137 CALCULATION OF THE DISCHARGE BEHAVIOR OF LEAD BATTERIES. Runge, W. Arch. Elektrotech. (Berlin); 57: No. 5, 235-246(Dec 1975). (In German).

To calculate the terminal voltage of a lead--acid battery, which depends on the degree of discharge and on the current, the following considerations are presented: the ohmic resistance; the activation overvoltage, which gives a current--voltage characteristic similar to that of a diode; and the concentration overvoltage, which is determined by the diffusion of the electrolyte. The diffusion can be electrically modelled by pieces of Thomson cables. The equivalent circuit and the treatment of the problem are considerably simplified by regarding the stationary state to which the effect due to a superposed alternating component (load cycles) can be added. The data needed for the calculation can be determined by measurements. The conformity of the calculated and the measured behavior is good.

138 METHOD TO OPERATE MULTICELL ACCUMULATORS FOR BATTERY-POWERED VEHICLES. Salamon, K. (to GES Gesellschaft fuer Elektrischen Strassenverkehr mbH). German(FRG) Patent 2,350,353/A/. 24 Apr 1975. 12p. (In German).

1 fig..

The patent describes a method of operating multicell accumulators for battery-charged vehicles. During operation of the batteries, only partial charging or charging up to a charging factor 1 at the highest are carried out in the vehicle while full charging and compensation charging are carried out in stationary battery charging stations. The gaseous hydrogen and oxygen formed during charge are led into a recombination reactor, where they are recombined into water, and then recirculated into the central water refill system of the accumulator by means of a pump. The cells are aired in order to provide mixing and cooling of the electrolyte.

139 FUEL FOR THOUGHT (ELECTROCHEMICAL ENERGY). Hart, A.B. (Cent. Electr. Res. Lab., Leatherhead, England). Chem. Br.; 11: No. 2, 55-9(1975).

Review with 15 references. HYDROGEN PRODUCTION;FUEL CELLS;ELECTROLYSIS;ELECTRIC BATTERIES;REVIEWS

140 SODIUM--SULFUR BATTERIES. Marcoux, L.S.; Seo, E.T. (TRW Syst. Group, TRW Inc., Redondo

Beach, CA). Adv. Chem. Ser.; 140 (New Uses Sulfur, Symp., 1974): 216-27(1975).
SODIUM-SULFUR BATTERIES;REVIEWS

141 RESEARCH TRENDS IN BATTERIES AND FUEL CELLS WITH REGARD TO FUTURE ENERGY SUPPLIES. Binder, H.; Sandstede, G. (Battelle-Inst. e.V., Frankfurt/Main, Germany). Chem.-Ing.-Tech.; 47: No. 2, 51-6(1975).
55 references. ELECTRIC BATTERIES;FUEL CELLS; REVIEWS;RESEARCH PROGRAMS

142 TENTH INTERSOCIETY ENERGY CONVERSION ENGINEERING CONFERENCE, NEWARK, DELAWARE, AUGUST 18--22, 1975. New York; Institute of Electrical and Electronics Engineers, Inc. (1975). 1572p. (CONF-750812--). $50.00.
From 10. intersociety energy conversion engineering conference; Newark, Delaware, USA (17 Aug 1975).
LEADING ABSTRACT;MEETINGS;HYDROGEN FUELS; SOLAR ENERGY;FUEL CELLS;ENERGY STORAGE;POWER GENERATION;ELECTRIC BATTERIES;SYNTHETIC FUELS; ENERGY CONVERSION;WIND POWER;STIRLING ENGINES

143 BATTERY ENERGY STORAGE FOR UTILITY LOAD LEVELING AND ELECTRIC VEHICLES: A REVIEW OF ADVANCED SECONDARY BATTERIES. Yao, N.P. (Argonne National Lab., IL); Birk, J.R. pp 1107-1119 of Tenth intersociety energy conversion engineering conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1975).
From 10. intersociety energy conversion engineering conference; Newark, Delaware, USA (17 Aug 1975).
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OFF-PEAK ENERGY STORAGE;ELECTRIC-POWERED VEHICLES;REVIEWS;ELECTRIC BATTERIES;LOAD MANAGEMENT

144 SOLID ELECTROLYTE ELECTROCHEMICAL GENERATORS. Feuillade, G. (Cent. Rech., Cie. Gen. Electr., Marcoussis, France). Rev. Gen. Electr.; 84: No. 6, 485-90(1975).
ELECTRIC BATTERIES;SOLIDS;ELECTROLYTES; REVIEWS

145 HOMEGROWN ENERGY: POWER FOR THE HOME AND HOMESTEAD. Wade, G.; Hartmann, M.; Hartmann, S. Willits, CA; Oliver Press (1975). 160p. Oliver Press, 1400 Ryan Creek Rd., Willits, CA 95490 $3.95.
Two cross-referenced indexes furnish information on what energy products are available to the do-it-yourselfer and who sells them. The Master Index lists products alphabetically by category. Categories include, for example, 34 items under solar and 10 company names under solar water heaters. The Company Index lists detailed information, including address, available products, specifications, sales procedures, and catalog descriptions for each company. (DCK)

146 POWER SOURCES 5. RESEARCH AND DEVELOPMENT IN NON-MECHANICAL ELECTRICAL POWER SOURCES. PROCEEDINGS OF THE 9TH INTERNATIONAL SYMPOSIUM HELD AT BRIGHTON, ENGLAND, SEPTEMBER 1974. Collins, D.H. (ed.). New York; Academic Press Inc. (1975). 753p. (CONF-740908--). $54.50.
From 9. international power sources symposium; Brighton, UK (17 Sep 1974).
Papers presented at the symposium cover electrical power sources of all types other than rotating machinery. Primary emphasis is on batteries. Of the 47 papers presented, abstracts of 31 appear separately in ERA. (GHT)

147 BEHAVIORAL EFFECTS OF OCCUPATIONAL EXPOSURE TO LEAD. Repko, J.D.; Morgan, B.B.; Nicholson, J. Cincinnati; National Institute for Occupational Safety and Health (1975). 239p.
A final report on controlled studies in which 80 behavioral tests were performed in 316 lead-exposed subjects (5 levels of body burden were distinguished) engaged in storage battery manufacture with statistical analysis of the results. Intellectual functions were not affected by lead exposure, whereas sensory (hearing), neuromuscular and psychomotor, and psychological functions all were. Neuromuscular and psychomotor functions showed the greatest effect: major changes occurred at blood lead (PbB) levels of 70 to 79 μg percent. PbB levels are not a sensitive measure of changes in functional capacity, blood aminolevulinic acid dehydratase (ALA-D) being found the most sensitive predictor of task performance. Recommendations are made for a biomedical standard of 70 μg percent for PbB, and of 21 units of ALA-D activity, as well as on the use of functional tests in routine monitoring of exposed workers. Directions for future research. Numerous appendices.

148 STORAGE BATTERIES. Baranov, B. Tekh. Vooruzhenie; 33: No. 3, 36-37(1975). (In Russian).
ELECTRIC BATTERIES;REVIEWS

149 NICKEL--CADMIUM BATTERY. APPLICATION ENGINEERING HANDBOOK. Grant, J.C. (ed.). Gainesville, FL; General Electric Co. (1975). vp.
This handbook includes characteristic data and the capabilities and limitations of nickel--cadmium batteries, along with other important engineering information needed for properly applying these batteries to specific end product requirements. It is also designed to acquaint the reader with the versatility and unique combination of product features of nickel--cadmium batteries that represent value for new ideas and concepts. Sealed and vented rechargeable cells are covered; hermetically sealed aerospace cells are not treated. The material is arranged under the following section headings: introduction; general description of nickel--cadmium cells and batteries; application information; charge characteristics; charging methods; discharge characteristics; battery life, storage, and maintenance; and General Electric nickel--cadmium battery products. 141 figures, 12 tables. (RWR)

150 BATTERY COUNCIL INTERNATIONAL CONVENTION: 1975. Chicago; Battery Council International (1975). 180p. (CONF-7504129--).
From 87. Battery Council International convention; Hollywood, Florida, USA (8 Apr 1975).
Separate abstracts were prepared for seventeen of the reports contained in this volume. (RWR)

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Several available systems relying upon either flywheel or battery storage of energy are described. Battery systems are shown to have several advantages. (Electr. Electron Abstr.)

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Various energy storage systems are briefly discussed. The systems include pumped hydroelectric, compressed air, and electric batteries. (TFD)

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Metal-semiconductor barrier. SCHOTTKY EFFECT; SEMICONDUCTOR MATERIALS;SCHOTTKY BARRIER DIODES; ELECTRIC BATTERIES;FUEL CELLS;DIFFUSION;IONS; IMPURITIES

154 NICKEL--CADMIUM BATTERIES PROVIDE LONG-LASTING, PORTABLE POWER. Mueller, B. Electron. Prod. (Garden City, N.Y.); 16: No. 9, 129-33(Feb 1974).
Descriptive, popular-type article. NICKEL-CADMIUM BATTERIES;PERFORMANCE;BATTERY CHARGING; DESIGN;OPERATION

155 ELECTROCHEMICAL SOURCES OF POWER: BATTERIES. pp 47-62 of Electrochemistry for ecologists. Chapter 4. Bockris, J.O'M. (Flinders Univ., South Australia); Nagy, Z. (Diamond Shamrock Chemical Co., Painesville, OH). New York-London; Plenum Press (1974).
Book chapter. OFF-PEAK ENERGY STORAGE; ELECTRIC-POWERED VEHICLES;ELECTRIC BATTERIES; DESIGN;PERFORMANCE

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157 ELECTROCHEMICAL GENERATORS. Korovin, N.V. Moscow, USSR; Energiya (1974). 207p. Ruble 0.59.
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From 9. Intersociety Energy Conversion Engineering Conference; San Francisco, California, USA (26 Aug 1974).
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248 (AD--356992) RESEARCH AND DEVELOPMENT OF A HIGH-ENERGY NONAQUEOUS BATTERY. QUARTERLY TECHNICAL REPORT NO. 6, 18 JUN--18 SEP 1964. (Electrochimica Corp., Menlo Park, Calif. (USA)). Oct 1964. Contract NOW-63-0618. 18p.
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254 (AD--433543) LITHIUM ANODE LIMITED-CYCLE SECONDARY BATTERY. QUARTERLY TECHNICAL PROGRESS REPORT NO. 3. Bauman, H.F. (Lockheed Missiles and Space Co., Palo Alto, Calif. (USA)). Mar 1964. Contract AF33(657)-11709. 15p.
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279 (AD--471950) LABORATORY INVESTIGATION AND ENGINEERING DESIGN LEADING TOWARDS THE DEVELOPMENT OF A LIGHTWEIGHT SECONDARY OR PRIMARY CELL TYPE BATTERY FOR ONE-SHOT APPLICATION. QUARTERLY REPORT NO. 10. (Eagle-Picher Co., Joplin, Mo. (USA). Storage Battery Div.). Feb 1948. Contract W36-039SC35548. vp.
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283 (AD--471978) LABORATORY INVESTIGATION AND ENGINEERING DESIGN LEADING TOWARDS THE DEVELOPMENT OF A LIGHTWEIGHT SECONDARY OR PRIMARY CELL TYPE BATTERY FOR ONE-SHOT APPLICATION. QUARTERLY REPORT NO. 8 (FINAL). (Eagle-Picher Co., Joplin, Mo. (USA). Storage Battery Div.). Dec 1949. Contract W36-039SC35548. vp.
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289 (AD--477937) LITHIUM ANODE LIMITED-CYCLE BATTERY INVESTIGATION. QUARTERLY TECHNICAL PROGRESS REPORT NO. 4. Bauman, H.F. (Lockheed Missiles and Space Co., Palo Alto, Calif. (USA). Materials Sciences Lab.). Feb 1966. Contract AF33(615)-2455. 37p.
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291 (AD--482897) SILVER--ZINC MISSILE POWER SUPPLY. QUARTERLY TECHNICAL PROGRESS REPORT NO. 3, 1 JAN--31 MAR 1966. Chireau, R.F. (Yardney Electric Corp., New York (USA)). Apr 1966. Contract AF33(615)-2663. 75p.
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292 (AD--483237) LITHIUM ANODE LIMITED-CYCLE BATTERY INVESTIGATION. QUARTERLY TECHNICAL PROGRESS REPORT NO. 5. Bauman, H.F. (Lockheed Missiles and Space Co., Palo Alto, Calif. (USA). Materials Sciences Lab.). May 1966. Contract AF33(615)-2455. 27p.
Development of $Li/CuF_2$ and $Li/CoF_3$ batteries, 25 Ah. METAL-NONMETAL BATTERIES; LITHIUM;DESIGN;COPPER FLUORIDES;CATHODES; CRYSTAL STRUCTURE;SOLUBILITY;CARBONIC ACID ESTERS;COBALT FLUORIDES

293 (AD--483724) NEW LASER POWER SUPPLY. Cason, C. (Army Missile Command, Redstone Arsenal, Ala. (USA). Physical Sciences Lab.). Jul 1964. 29p.
250,000 $kW/m^3$, stored energy = 75 x $10^6$ J/ $m^3$. LASERS;FLASH TUBES;POWER SUPPLIES; FEASIBILITY STUDIES;ELECTRIC BATTERIES;DESIGN; RECOMMENDATIONS

294 (AD--484014) RESEARCH ON A HIGH-ENERGY NONAQUEOUS BATTERY SYSTEM. QUARTERLY PROGRESS REPORT NO. 1, 1 DEC 1965--1 MAR 1966. (Electrochimica Corp., Menlo Park, Calif. (USA)). Mar 1966. Contract NOW-66-0342. 29p.
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295 (AD--484015) RESEARCH ON A HIGH-ENERGY NONAQUEOUS BATTERY SYSTEM. QUARTERLY PROGRESS REPORT NO. 2, 1 MAR--31 MAY 1966. (Electrochimica Corp., Menlo Park, Calif. (USA)). Jun 1966. Contract NOW-66-0342. 27p.
503 Wh/lb (theo.), 75 Wh/lb achieved in 1Ah. LITHIUM-COPPER CHLORIDE BATTERIES;CARBONIC ACID ESTERS;LACTONES;PERFORMANCE

296 (AD--484494) INVESTIGATION OF HERMETICALLY SEALED, MAINTENANCE-FREE, HIGH-RATE, NICKEL--CADMIUM BATTERIES FOR AIRCRAFT APPLICATIONS. QUARTERLY TECHNICAL PROGRESS REPORT NO. 7. Kantner, E.; Ritterman, P.; Tarantino, R.V.; Shair, R.C. (Gulton Industries, Inc., Metuchen, N.J. (USA)). Jun 1966. Contract AF33(615)-2087. 67p.
SEALS;NICKEL-CADMIUM BATTERIES;AIRCRAFT; DESIGN;FABRICATION;BATTERY CHARGING

297 (AD--488983) SILVER--ZINC MISSILE POWER SUPPLY. QUARTERLY TECHNICAL PROGRESS REPORT NO. 4, 1 APR--30 JUN 1966. Chireau, R.F. (Yardney Electric Corp., New York (USA)). Jul 1966. Contract AF33(615)-2663. 149p.
750 Wh, 2 to 20 kW. MISSILES;SILVER-ZINC BATTERIES;HYDROXIDES;DESIGN;WEIGHT;SIZE;DC TO DC CONVERTERS;POTASSIUM HYDROXIDES;ELECTRIC POTENTIAL;DIAGRAMS

298 (AD--489624) LITHIUM ANODE LIMITED CYCLE BATTERY INVESTIGATION. QUARTERLY TECHNICAL PROGRESS REPORT NO. 6. Bauman, H.F.; Chilton, J.E.; Hultquist, A.E. (Lockheed Missiles and Space Co., Palo Alto, Calif. (USA). Materials Sciences Lab.). Aug 1966. Contract AF33(615)-2455. 40p. (LMSC/M--89-66-2).
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299 (AD--491831) LABORATORY INVESTIGATIONS AND RESEARCH TOWARD THE DEVELOPMENT OF NICKEL--CADMIUM ALKALINE STORAGE BATTERIES. QUARTERLY PROGRESS REPORT, 1 OCT--31 DEC 1947. Fleischer, A. (Nickel Cadmium Battery Corp., Easthampton, Mass. (USA)). Dec 1947. 97p.
Electrode processes, quantity production of sintered plates. NICKEL-CADMIUM BATTERIES; HYDROXIDES;ELECTRODES;CHEMICAL REACTIONS; SINTERED MATERIALS;PLATES;FABRICATION;THICKNESS; POROSITY;LITHIUM HYDROXIDES;LITHIUM NITRATES; ELECTROCHEMISTRY;IMPREGNATION;CHEMICAL REACTION KINETICS

300 (AD--493497) LABORATORY INVESTIGATIONS AND RESEARCH TOWARD THE IMPROVEMENT OF SINTERED-PLATE ALKALINE STORAGE BATTERIES. PROGRESS REPORT NO. 1 FOR PERIOD ENDING 31 OCT 1948. Fleischer, A. (Nickel Cadmium Battery Corp., Easthampton, Mass. (USA)). Oct 1948. Contract W-36-039-SC-38156.
SINTERED MATERIALS;PLATES;HYDROXIDES;TESTING; IRON-NICKEL BATTERIES;STABILITY;ELECTRICAL PROPERTIES

301 (AD--493498) LABORATORY INVESTIGATIONS AND RESEARCH TOWARD THE IMPROVEMENT OF SINTERED-PLATE ALKALINE STORAGE BATTERIES. FINAL REPORT. Fleischer, A. (Nickel Cadmium Battery Corp., Easthampton, Mass. (USA)). Jun 1950. Contract W-36-039-SC-38156. 37p.
SINTERED MATERIALS;PLATES;HYDROXIDES; THICKNESS;ELECTRODES;WEIGHT;POLARIZATION; ELECTRIC POTENTIAL;NICKEL-CADMIUM BATTERIES; RESEARCH PROGRAMS

302 (AD--495876) PROGRESS REPORT. Bowers, F.M. (Thomas A. Edison Industries, West Orange, N.J. (USA)). Dec 1946. Contract W-36-039-SC-32137. 25p.
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304 (AD--495878) PROGRESS REPORT. Bowers, F.M. (Thomas A. Edison Industries, West Orange, N.J. (USA)). May 1947. Contract W-36-039-SC-32137. 84p.

Development of Ni/Cd batteries with sintered electrodes. HYDROXIDES;NICKEL-CADMIUM BATTERIES; ELECTRIC POTENTIAL;LIFETIME;SINTERED MATERIALS; ELECTRODES;RADIO EQUIPMENT POWER SUPPLIES; DESIGN

305 (AD--496061) SERVICES, FACILITIES, AND MATERIALS LEADING TO THE DESIGN, DEVELOPMENT, AND PRODUCTION OF SPECIAL PURPOSE BATTERIES. QUARTERLY REPORT NO. 7. (Eagle-Picher Co., Joplin, Mo. (USA)). Apr 1952. 17p.
SILVER-ZINC BATTERIES;DESIGN;FABRICATION; HYDROXIDES;SILVER OXIDES;SILVER;GRIDS;ANODES; ELECTRIC POTENTIAL;SPECIFICATIONS;CONTAINERS

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Development of alkaline battery. SUBMARINES; IRON-NICKEL BATTERIES;DESIGN;FABRICATION; HYDROXIDES;ELECTRIC POTENTIAL;DIRECT CURRENT; SPECIFICATIONS;HYDROGEN;BATTERY CHARGERS; LIFETIME

307 (AD--499471) FUNDAMENTAL BATTERY STUDIES. QUARTERLY REPORT NO. 4. Kissin, G.H. (Georgia Inst. of Tech., Atlanta (USA). Engineering Experiment Station). Sep 1947. Contract W-36-039-SC-32239. 9p.
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308 (AD--499477) IMPROVED BATTERIES. QUARTERLY REPORT NO. 11, 15 DEC 1948--15 MAR 1949. Garrett, A.B. (Ohio State Univ. Research Foundation, Columbus (USA)). Mar 1949. Contract W-36-039-SC-32270. 27p.
Ohio State Univ. ZINC OXIDES;ELECTRIC BATTERIES;RESEARCH PROGRAMS;PRIMARY BATTERIES; ZINC;MERCURY OXIDES;POLARIZATION;METAL-NONMETAL BATTERIES;ZINC;IODINE;STORAGE;METAL-METAL OXIDE BATTERIES;ZINC;LITHIUM CHLORIDES;SODIUM COMPOUNDS;CHROMATES;MANGANESE OXIDES;;SOLVENTS; ELECTROLYTES;PHYSICAL PROPERTIES

309 (AD--499967) THIN-CELL STORAGE BATTERY. FINAL TECHNICAL REPORT. Bennett, D.E.; Matsch, L.W. (Armour Research Foundation, Chicago, Ill. (USA)). Nov 1947. Contract W-11-022-ORD-11164. 68p. (ARF--90-391-E-F).
Power source for electric gun. LEAD-ACID BATTERIES;FEASIBILITY STUDIES;FOILS; POLYETHYLENES;VENTS;SEALS;GLASS;TEXTILES; PLASTICS;PLATES;DISTANCE;GUNS;POLYVINYLS

310 (AD--600251) INVESTIGATIONS LEADING TO THE DESIGN OF A RELIABLE SEALED NICKEL--CADMIUM CELL. REPORT NO. 7 (QUARTERLY PROGRESS REPORT NO. 3), 1 NOV 1963--31 JAN 1964. Gosch, C.O. (Eagle-Picher Co., Joplin, Mo. (USA)). Feb 1964. 80p.
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311 (AD--600395) DEVELOPMENT OF THE SEALED ZINC--SILVER OXIDE SECONDARY BATTERY SYSTEM. QUARTERLY PROGRESS REPORT NO. 2, 1 OCT--30 DEC 1963. Sulkes, M. (Yardney Labs., Inc., New York (USA)). Dec 1963. Contract DA36-039AMC02238E. 83p.
12 Ah. SEALS;SILVER-ZINC BATTERIES;SILVER OXIDES;DESIGN;MEDIUM TEMPERATURE;PERFORMANCE; CHEMICAL REACTIONS;OXYGEN;ZINC;RECOMBINATION; BATTERY CHARGING;BATTERY SEPARATORS;FABRICATION

312 (AD--600634) WEAPON SYSTEM 107A-1. MARK 3 ADVANCED RE-ENTRY VEHICLE PROGRAM. CHEMICAL ENERGY SOURCES. FINAL SUMMARY REPORT. Hawn, C.D. (General Electric Co., Philadelphia, Pa. (USA). Missile and Space Div.). Nov 1961. Contract AF04(647)-269. 15p. (R--60SD66-1-2).
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313 (AD--601128) LIMITED-CYCLE SECONDARY BATTERY USING LITHIUM ANODE. FINAL REPORT. Bauman, H. (Lockheed Missiles and Space Co., Sunnyvale, Calif. (USA)). May 1964. Contract AF33(657)-11709. 35p.
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314 (AD--601148) LITHIUM--NICKEL HALIDE SECONDARY BATTERY INVESTIGATION. QUARTERLY TECHNICAL PROGRESS REPORT NO. 2. Lyall, A.E.; Seiger, H.N. (Gulton Industries, Inc., Metuchen, N.J. (USA)). Jun 1964. Contract AF33(615)-1266. 23p.
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315 (AD--601583) DESIGN, FABRICATION AND TESTING OF VENTED, RECHARGEABLE SILVER--CADMIUM CELLS. QUARTERLY PROGRESS REPORT NO. 3, 1 JAN--31 MAR 1964. Harmyk, J.A.; Brent, J.H. Jr. (Gulton Industries, Inc., Metuchen, N.J. (USA)). Mar 1964. Contract DA36-039AMC03359E. 17p.
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316 (AD--603023) APPLIED RESEARCH INVESTIGATION OF SEALED SILVER--ZINC BATTERIES. Lander, J.J.; Cooke, L.M.; Scardaville, P.A. (General Motors Corp., Anderson, Ind. (USA). Delco-Remy Div.). Aug 1964. Contract AF33(657)-10643. 363p.
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317 (AD--605754) LITHIUM--NICKEL HALIDE SECONDARY BATTERY INVESTIGATION. QUARTERLY TECHNICAL PROGRESS REPORT NO. 3. Lyall, A.E.; Seiger, H.N. (Gulton Industries, Inc., Metuchen, N.J. (USA)). 16 Sep 1964. 2p. NTIS $3.00.
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318 (AD--607968) LITHIUM--SILVER CHLORIDE SECONDARY BATTERY INVESTIGATION. QUARTERLY TECHNICAL PROGRESS REPORT NO. 3. Chilton,

J.E. Jr.; Holsinger, R.W. (Lockheed Missiles and Space Co., Palo Alto, Calif. (USA)). Oct 1964. Contract AF33(615)-1195. 30p.
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319 (AD--610010) STANDARD LINE ALKALINE SECONDARY BATTERIES. Settembre, E.J. (Army Electronics Labs., Fort Monmouth, N.J. (USA)). Jul 1964. 25p.
NICKEL-CADMIUM BATTERIES;SILVER-ZINC BATTERIES;SILVER OXIDES;SILVER-CADMIUM BATTERIES;DESIGN;CONTAINERS;PLASTICS;HYDROXIDES

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321 (AD--612189) LITHIUM--SILVER CHLORIDE SECONDARY BATTERY INVESTIGATION. FINAL REPORT, DEC 1963--NOV 1964. Chilton, J.E. Jr.; Conner, W.J.; Cook, G.M.; Holsinger, R.W. (Lockheed Missiles and Space Co., Sunnyvale, Calif. (USA)). Feb 1965. Contract AF33(615)-1195. 109p.
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324 (AD--615342) INVESTIGATIONS LEADING TO THE DESIGN AND DEVELOPMENT OF MAGNESIUM/ MAGNESIUM PERCHLORATE BATTERIES. QUARTERLY PROGRESS REPORT NO. 2, 1 OCT--31 DEC 1964. Sharpe, J. (Eagle-Picher Co., Joplin, Mo. (USA)). Jan 1965. Contract DA28-043AMC00221E. 42p.
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325 (AD--617333) THEORETICAL DESIGN OF PRIMARY AND SECONDARY CELLS. PART IV. FURTHER STUDIES OF THE BATTERY DISCHARGE EQUATION. Shepherd, C.M. (Naval Research Lab., Washington, D.C. (USA)). Nov 1964. 29p. (NRL--6129).
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326 (AD--617406) ADVANCED DEVELOPMENT MODELS OF VENTED NICKEL--CADMIUM BATTERIES. FINAL REPORT FOR 5 APR 1964--15 MAR 1965. Wilson, J.K. (Eagle-Picher Co., Joplin, Mo. (USA)). Mar 1965. Contract DA28-043AMC000065E. 20p.
VENTS;NICKEL-CADMIUM BATTERIES;HYDROXIDES; DESIGN;FABRICATION;TESTING

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328 (AD--620178) DESIGN, DEVELOPMENT, AND ENVIRONMENTAL TEST REPORT ON RADIO SET AN/PRC-63 (XN-1). (Sylvania Electronic Systems, Waltham, Mass. (USA)). Jul 1965. Contract NOW-63-0286. 96p. (F--150-1).
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329 (AD--621583) DEVELOPMENT OF THE SEALED ZINC--SILVER OXIDE SECONDARY BATTERY SYSTEM. QUARTERLY PROGRESS REPORT NO. 7, 1 JAN--31 MAR 1965. Sulkes, M. (Yardney Electric Corp., New York (USA)). Mar 1965. Contract DA36-039AMC02238. 51p.
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330 (AD--622822) INVESTIGATIONS LEADING TO THE DESIGN AND DEVELOPMENT OF MAGNESIUM/ MAGNESIUM PERCHLORATE BATTERIES. REPORT NO. 4 (FINAL), 1 JULY 1964--30 JUNE 1965. Sharpe, J.R. (Eagle-Picher Industries, Inc., Joplin, Mo. (USA). Couples Dept.). Jul 1965. Contract DA28-043-AMC-00221(E). 91p.
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331 (AD--622907) LABORATORY INVESTIGATIONS AND RESEARCH TOWARD THE DEVELOPMENT OF NICKEL--CADMIUM ALKALINE STORAGE BATTERIES. QUARTERLY PROGRESS REPORT NO. 2. (Nickel Cadmium Battery Corp., Easthampton, Mass. (USA)). Dec 1946. Contract W37-039SC32271. 8p.
NICKEL-CADMIUM BATTERIES;HYDROXIDES;RESEARCH PROGRAMS;MATERIALS;PLANNING

332 (AD--622908) LABORATORY INVESTIGATIONS AND RESEARCH TOWARD THE DEVELOPMENT OF NICKEL--CADMIUM ALKALINE STORAGE BATTERIES. QUARTERLY PROGRESS REPORT NO. 1. (Nickel Cadmium Battery Corp., Easthampton, Mass. (USA)). Sep 1946. Contract W36-039SC32271. 20p.
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333 (AD--623024) ADVANCED DEVELOPMENT MODELS OF SEALED NICKEL--CADMIUM BATTERIES. FINAL REPORT FOR 5 APRIL 1964--16 AUGUST 1965. Wilson, J.K. (Eagle-Picher Industries, Inc., Joplin, Mo. (USA). Couples Dept.). Aug 1965. Contract DA28-043-AMC-00070(E). 20p.
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334 (AD--628961) HIGH-ENERGY SYSTEM (ORGANIC ELECTROLYTE). QUARTERLY REPORT NO. 1, 15 JUNE--15 SEPTEMBER 1965. Boden, D.P.; Buhner, H.R.; Spera, V.J. (Electric Storage Battery Co., Yardley, Pa. (USA)). Oct 1965. Contract DA-28-043-AMC-01394(E). 82p.
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335 (AD--629501) THIN-FILM RECHARGEABLE SOLID-ELECTROLYTE BATTERIES. REVISED ED. Mrgudich, J.N.; Bramhall, P.J.; Finnegan, J.J. (Army Electronics Command, Fort Monmouth, N.J. (USA). Inst. for Exploratory Research). Sep 1965. 8p. IEEE Trans. Aerospace Electron. Syst.; 1: No. 3, 290-296(Dec 1965).
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336 (AD--630691) HIGH-ENERGY SYSTEM (ORGANIC ELECTROLYTE). QUARTERLY REPORT NO. 2, 15 SEPTEMBER--15 DECEMBER 1965. Boden, D.P.; Buhner, H.R.; Spera, V.J. (Electric Storage Battery Co., Yardley, Pa. (USA)). Jan 1966. Contract DA-28-043-AMC-01394(E). 99p.
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337 (AD--631271) STANDARD LINE-BATTERY ASSEMBLY BB-610( )/U NICKEL CADMIUM VENTED. QUARTERLY REPORT NO. 1, 25 JUNE--28 OCTOBER 1965. Herrmann, J.; Fitchman, A.; Nathe, R. (Sonotone Corp., Elmsford, N.Y. (USA)). Oct 1965. 31p.
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436 (AD--774308) INVESTIGATION OF HIGH-TEMPERATURE BATTERY SYSTEMS. FINAL TECHNICAL REPORT, 1 JUL 1972-31 OCT 1973. Seo, E.T.; Sayano, R.R.; Carroll, D.F.; McIanahan, M.L.; Silverman, H.P. (TRW, Inc., Cleveland, Ohio (USA)). Jan 1974. Contract DAAB07-72-C-0312. 46p. (TRW--23323-6015-RU-00; ECOM--0312-F). NTIS.
SODIUM-SULFUR BATTERIES;HIGH TEMPERATURE; FABRICATION;TESTING;SEALS

437 (AD--774811) NICKEL--CADMIUM MONOBLOCK BATTERY BB-433(X-1)/A. FINAL REPORT, APR 1971--FEB 1974. Hill, J.M.; McCarter, W.K. (Eagle-Picher Industries, Inc., Colorado Springs, Colo. (USA). Precision Products Dept.). Feb 1974. Contract DAAB07-71-C-0269. 37p. (ECOM--0269-F-71). NTIS.
NICKEL-CADMIUM BATTERIES;AIRCRAFT; PERFORMANCE;DESIGN;HIGH TEMPERATURE;FABRICATION; CONTAINERS

438 (AD--777665) POSSIBILITIES FOR INCREASING THE TECHNICAL LEVEL AND SPECIFIC WEIGHT AND VOLUMETRIC ELECTRICAL RATING CHARACTERISTICS OF CHEMICAL SOURCES OF CURRENT. Ogromnov, P.V.; Savelchikov, I.P. (Foreign Technology Div., Wright-Patterson AFB, Ohio (USA)). 21 Mar 1974. 15p. (FTD-MT--24-400-74). NTIS $3.00; $1.45 (mf).
Edited machine translation of Vses. Nauchno-Issled. Akkumuliatornyi Inst. Sb. Rab. po Khim. Istochnikam Toka (USSR), No. 4, 3-10(1969), by Charles T. Ostertag, Jr..
ELECTRIC BATTERIES;LEAD-ACID BATTERIES; NICKEL-CADMIUM BATTERIES;SILVER-ZINC BATTERIES; PRODUCTION;IRON

439 (AD--777665) POSSIBILITIES FOR INCREASING THE TECHNICAL LEVEL AND SPECIFIC WEIGHT AND VOLUMETRIC ELECTRICAL RATING CHARACTERISTICS OF CHEMICAL SOURCES OF CURRENT. Ogromnov, P.V.; Savelchikov, L.P. (Foreign Technology Div., Wright-Patterson AFB, Ohio (USA)). Mar 1974. 15p. (FTD-MT--24-400-74). NTIS.
Edited machine translation of Vses. Nauch.-Issled. Akkum. Inst. Sb. Rabot po Khm. Istoch. Toka (USSR], No. 4, 3-10(1969).
Lead--acid, nickel--cadmium, silver--zinc. LEAD-ACID BATTERIES;NICKEL-CADMIUM BATTERIES; SILVER-ZINC BATTERIES;PRODUCTION;IRON;ELECTRIC BATTERIES

440 (AD--777857) NEW CATHODE MATERIAL FOR HIGH-ENERGY-DENSITY BATTERIES. FINAL REPORT, 1 SEP 1972--30 JUN 1973. Nicholson, M.M. (Atomics International Div., Canoga Park, Calif. (USA)). 31 Jul 1973. Contract F-19628-72-C-0147. 44p. (AI--73-51; AFCRL-TR--73-0568). NTIS $3.25; $1.45 (mf).
Li/fluorides. METAL-NONMETAL BATTERIES; LITHIUM;CADMIUM FLUORIDES;MANGANESE FLUORIDES; NICKEL FLUORIDES;N-TYPE CONDUCTORS;FABRICATION; PERFORMANCE TESTING

441 (AD--778825) ADVANCED LITHIUM--WATER BATTERY FOR ELECTRONIC COUNTERMEASURE DEVICES. REPORT FOR 1 NOVEMBER 1972--1 NOVEMBER 1973. Bauman, H.F. (Lockheed Missiles and Space Co., Palo Alto, Calif. (USA). Lockheed Palo Alto Research Lab.). 26 Nov 1973. Contract F33615-73-C-2021. 57p. (LMSC-D--356295). NTIS $3.75.
Development studies on electrolytes and cathodes. METAL-NONMETAL BATTERIES;LITHIUM; WATER;ELECTROLYTES;CATHODES;CATALYSTS;LITHIUM HYDROXIDES;ELECTROCHEMISTRY;EFFICIENCY;ELECTRIC CURRENTS;ELECTRIC CONDUCTIVITY;ADDITIVES; PERFORMANCE TESTING

442 (AD--779175) NEW ELECTROCHEMICAL SOURCES OF ENERGY. Bagotskii, V.S. (Foreign Technology Div., Wright-Patterson AFB, Ohio (USA)). 16 Apr 1974. 21p. (FTD-HT--23-0012-74). NTIS $3.00; $1.45 (mf).
Edited translation of Vsesoyuznoe Khimicheskoe Obshchestvo. Zhurnal (USSR), 16: No. 6, 685-90(1971), by Charles T. Ostertag, Jr..
ELECTRIC BATTERIES;FUEL CELLS;REVIEWS; CATALYSTS

443 (AD--780940) PRODUCTION AND ENGINEERING METHODS FOR CARB-TEK (TRADEMARK) BATTERIES IN FORK LIFT TRUCKS. INTERIM REPORT, JUL 1973-JAN 1974. Metcalfe, J.E. Mar 1974. Contract DAAK-02-73-C-0493. 28p. NTIS $3.25; $1.45 (mf).
Li--Al/KCl--LiCl/C. ELECTRIC-POWERED VEHICLES;METAL-NONMETAL BATTERIES;FABRICATION; TELLURIUM CHLORIDES;POTASSIUM CHLORIDES;LITHIUM CHLORIDES;CARBON;ALUMINIUM ALLOYS;LITHIUM ALLOYS

444 (AD--781224) STUDY OF OPERATING MODES OF DIESEL LOCOMOTIVE ALKALINE STORAGE BATTERIES. Koshevoi, V.A. (Army Foreign Science and Technology Center, Charlottesville, VA). 6 Aug 1973. 14p. (FSTC-HT--23-1858-73). NTIS $4.00; $1.45 (mf).
IRON-NICKEL BATTERIES;MEDIUM TEMPERATURE; ELECTROCHEMISTRY;BATTERY CHARGING;ELECTRODES; LIFETIME;HEATING;RELIABILITY;DIESEL ENGINES

445 (AD--782059) RESEARCH AND DEVELOPMENT ON THE GLASS FIBER SODIUM--SULFUR BATTERY. SEMI-ANNUAL TECHNICAL REPORT. Levine, C.A. (Dow Chemical U.S.A., Walnut Creek, Calif.). 1 May 1974. Contract DAHC15-73-C-0254. 36p. NTIS $3.25; $1.45 (mf).
SODIUM-SULFUR BATTERIES;PERFORMANCE TESTING; DESIGN;FABRICATION;THERMAL TESTING;FIBERS;GLASS

446 (AD--782910) LEAD--ACID RESERVE BATTERY. Erisman, L.R. (Eagle-Picher Industries, Inc., Joplin, Mo. (USA). Couples Dept.). 1974. 38p. NTIS $5.00.
The development is discussed of a Pb-acid reserve battery identified as Eagle-Picher Battery no. GAP-1500. The overall program was divided in 2 major parts, battery electrochem. design and activation mechanism design incorporation. The final battery configuration is shown.Hamiltonian, a dynamic Jahn-Teller effect, and an Orbach mechanism involving an excited state at 1840 $cm^{-1}$.J

447 (AD--782910) LEAD--ACID RESERVE BATTERY. FINAL REPORT. Erisman, L.R. (Eagle-Picher Industries, Inc., Joplin, Mo. (USA). Couples Dept.). [nd]. Contract DAAA21-73-C-0540. 38p. NTIS $5.00.
LEAD-ACID BATTERIES;DESIGN;RELIABILITY

448 (AD--783490) SEALED ZINC--OXYGEN CELLS. TECHNICAL REPORT. Wagner, O.C. (Army Electronics Command, Fort Monmouth, N.J. (USA)). Aug 1974. 12p. (ECOM--74-4235). NTIS $3.00; $2.25 (mf).
ZINC-AIR BATTERIES;SEALS;OXYGEN;RELIABILITY; ZINC;ANODES;PERFORMANCE

449 (AD--784072) SEALED LITHIUM INORGANIC ELECTROLYTE CELL. QUARTERLY REPORT NO. 1, 1 MAR-31 MAY 1974. Marincic, N. (GTE Sylvania, Inc., Needham Heights, Mass. (USA)). Jul 1974. 27p. (ECOM--74-0108-1). NTIS $4.50; $2.25 (mf).
ELECTRIC BATTERIES;DESIGN;PERFORMANCE; BATTERY SEPARATORS;ELECTRODES;DIAGRAMS; SPECIFICATIONS;SEALS

450 (AD--784902) HYDROGEN--NICKEL REGENERATIVE FUEL CELLS. Swette, L.; Holleck, G.L. (Tyco Labs., Inc., Waltham, Mass. (USA)). 1974. 81p. NTIS $4.00.
50 A-hr. NICKEL-HYDROGEN BATTERIES; REGENERATIVE FUEL CELLS;DESIGN;FABRICATION; TESTING;SATELLITES;ENERGY STORAGE;PERFORMANCE; SPACECRAFT POWER SUPPLIES

451 (AD--800799) INVESTIGATION OF MAINTENANCE-FREE, HIGH-RATE, NICKEL--CADMIUM BATTERIES FOR AIRCRAFT APPLICATION. QUARTERLY TECHNICAL PROGRESS REPORT NO. 1. Kantner, E.; Wouk, V.; Lennon, H.; Ritterman, P. (Gulton Industries, Inc., Metuchen, N.J. (USA)). 1956. Contract AF33(615)-5357. 87p.
NICKEL-CADMIUM BATTERIES;DESIGN;BATTERY CHARGING;PERFORMANCE;RELIABILITY

452 (AD--802208) RESEARCH ON A HIGH-ENERGY NONAQUEOUS BATTERY SYSTEM. QUARTERLY PROGRESS REPORT NO. 3, 1 JUNE--31 AUGUST 1966. (Electrochimica Corp., Menlo Park, Calif. (USA)). Sep 1966. Contract NOW-66-0342. 47p.
LITHIUM-COPPER CHLORIDE BATTERIES; PERFORMANCE;FABRICATION;CHEMICAL REACTIONS; ELECTRODES;CHEMICAL REACTION KINETICS; ELECTROLYTES;POLARIZATION;POLYETHYLENES

453 (AD--802279) DEVELOPMENT OF MANUFACTURING METHODS AND TECHNIQUES FOR THE PRODUCTION OF IMPROVED ALKALINE BATTERIES. FINAL TECHNICAL REPORT, 1 APRIL 1965--30 JUNE 1966. Wagner, O.; Enters, R. (Yardney Electric Corp., New York (USA)). Sep 1966. Contract AF33(615)-2578. 176p.
Approximately 15 Ah, operate down to -30°F. HYDROXIDES;SATELLITES;NICKEL-CADMIUM BATTERIES; SILVER-CADMIUM BATTERIES;FABRICATION;LOW TEMPERATURE;MEDIUM TEMPERATURE;PERFORMANCE

454 (AD--802355) MAINTENANCE-FREE SILVER--CADMIUM BATTERIES FOR AIRCRAFT EMERGENCY

APPLICATIONS. QUARTERLY TECHNICAL PROGRESS REPORT NO. 5, 1 JUNE--31 AUG 1966. Goodkin, J. (Yardney Electric Corp., New York (USA)). Sep 1966. Contract AF33(615)-2615. 49p.
Two-level cells with third electrode. AIRCRAFT;SILVER-CADMIUM BATTERIES;HYDROXIDES; TESTING;IMPACT SHOCK;MECHANICAL VIBRATIONS; HEATING;WEIGHT;PERFORMANCE;MEDIUM TEMPERATURE; LOW TEMPERATURE;BATTERY CHARGING;POLARIZATION; ANODES

455 (AD--804103) LITHIUM ANODE LIMITED CYCLE BATTERY INVESTIGATION. QUARTERLY TECHNICAL PROGRESS REPORT NO. 7. Bauman, H.F.; Chilton, J.E.; Hultquist, A.E. (Lockheed Missiles and Space Co., Palo Alto, Calif. (USA). Lockheed Palo Alto Research Lab.). Nov 1966. Contract AF33(615)-2455. 24p.
Li/$CuF_2$ >25 Ah, 70 to 75 Wh/lb. METAL-NONMETAL BATTERIES;LITHIUM;COPPER FLUORIDES; ELECTRODES;OPTIMIZATION;FABRICATION;COPPER; POWDERS;CATHODES;ELECTRIC POTENTIAL

456 (AD--804558) SILVER--ZINC MISSILE POWER SUPPLY. QUARTERLY TECHNICAL PROGRESS REPORT NO. 5, 1 JULY--1 OCTOBER 1966 ON PHASE 1. Chireau, R.F. (Yardney Electric Corp., New York (USA)). Oct 1966. Contract AF33(615)-2663. 100p.
SILVER-ZINC BATTERIES;MISSILES;TESTING; DESIGN;DC TO DC CONVERTERS;ELECTRIC POTENTIAL; ELECTROLYTES;LEAKAGE CURRENT;HYDROXIDES

457 (AD--804814) HIGH-IMPACT, PLASTIC CASE, LEAD--ACID STORAGE BATTERY, TYPE 2HN. Reinman, J.H. (Army Tank-Automotive Center, Warren, Mich. (USA). Instrument-Electrical Lab.). Dec 1965. 31p.
LEAD-ACID BATTERIES;DESIGN;CONTAINERS; POLYCARBONATES;MATERIALS

458 (AD--808475) RESEARCH ON A HIGH-ENERGY NONAQUEOUS BATTERY SYSTEM. QUARTERLY PROGRESS REPORT NO. 4, 1 SEPTEMBER--30 NOVEMBER 1966. (Electrochimica Corp., Menlo Park, Calif. (USA)). Dec 1966. Contract NOW-66-0342. 27p.
4 Ah. LITHIUM-COPPER CHLORIDE BATTERIES; POLYPROPYLENE;SILVER OXIDES;CARBONIC ACID ESTERS;DESIGN;FABRICATION;TESTING;ORGANIC SOLVENTS;PVC;NITRO COMPOUNDS;ANODES;CHEMICAL REACTION KINETICS;BATTERY SEPARATORS;CATHODES; THICKNESS;PERFORMANCE;GRIDS

459 (AD--811343) SILVER--ZINC MISSILE POWER SUPPLY. QUARTERLY TECHNICAL PROGRESS REPORT NO. 6, 1 OCTOBER--31 DECEMBER 1966. Chireau, R.F. (Yardney Electric Corp., New York (USA)). Jan 1967. Contract AF33(615)-2663. 59p.
169 Wh. MISSILES;SILVER-ZINC BATTERIES; DESIGN;DC TO DC CONVERTERS;VOLUME;WEIGHT

460 (AD--813321) RESEARCH ON A HIGH-ENERGY NONAQUEOUS BATTERY SYSTEM. QUARTERLY PROGRESS REPORT NO. 5, 1 DECEMBER 1966--28 FEBRUARY 1967. (Electrochimica Corp., Menlo Park, Calif. (USA)). Mar 1967. 45p.
LITHIUM-COPPER CHLORIDE BATTERIES;GRIDS; BATTERY SEPARATORS;HEATING;HEAT TRANSFER; CORROSION;LEWIS ACIDS;ELECTROLYTES;ANODES; DIFFUSION;HYDROXIDES;ELECTRODES;PVC

461 (AD--814021) SILVER--ZINC MISSILE POWER SUPPLY. QUARTERLY PROGRESS REPORT NO. 7, 1 JANUARY--31 MARCH 1967. Chireau, R.F. (Yardney Electric Corp., New York (USA)). Apr 1967. Contract AF33(615)-2663. 72p.
MISSILES;SILVER-ZINC BATTERIES;DESIGN; PERFORMANCE TESTING;DC TO DC CONVERTERS; HYDROXIDES;FABRICATION;SPECIFICATIONS

462 (AD--816308) REVIEW OF AMMONIA BATTERY SYSTEMS AND AMMONIA ELECTROLYTES. LITERATURE SURVEY, 1 JUN 1966--9 JUN 1967. Hudson, P.E. (Tracor, Inc., Austin, Tex. (USA) ). Jun 1967. Contract DA-49-186-AMC-286(D). 173p.
ELECTRIC BATTERIES;REVIEWS;HYDROXIDES; AMMONIA

463 (AD--818309) INVESTIGATION OF MAINTENANCE-FREE HIGH-RATE, NICKEL--CADMIUM BATTERIES FOR AIRCRAFT APPLICATION. QUARTERLY TECHNICAL PROGRESS REPORT NO. 4, 1 MARCH--1 JUNE 1967. Kantner, E.; Lennon, H.J.; Wouk, V.; Gladstone, B. (Gulton Industries, Inc., Metuchen, N.J. (USA)). Jun 1967. 61p.
AIRCRAFT;NICKEL-CADMIUM BATTERIES;SEALS;LOW TEMPERATURE;POLYPROPYLENE;BATTERY SEPARATORS; MEDIUM TEMPERATURE;PACKAGING;LOGIC CIRCUITS; TESTING;ELECTRIC POTENTIAL;BATTERY CHARGING; PERFORMANCE

464 (AD--818935) RESEARCH ON A HIGH-ENERGY NONAQUEOUS BATTERY SYSTEM. QUARTERLY PROGRESS REPORT NO. 6, 1 MARCH--31 MAY 1967. (Electrochimica Corp., Menlo Park, Calif. (USA)). Jun 1967. 44p.
LITHIUM-COPPER CHLORIDE BATTERIES; PERFORMANCE;OPERATION;GRIDS;ELECTROLYTES; BATTERY SEPARATORS;ELECTRIC CONDUCTIVITY; POLARIZATION;CHEMICAL REACTION KINETICS;COPPER; COPPER CHLORIDES

465 (AD--819494) SILVER--ZINC POWER SUPPLY. QUARTERLY PROGRESS REPORT NO. 8, 31 MARCH--30 JUNE 1967 ON PHASE 2B. Chireau, R.F. (Yardney Electric Corp., New York (USA)). Aug 1967. 71p.
SILVER-ZINC BATTERIES;MISSILES;DESIGN; TESTING;DC TO DC CONVERTERS;HYDROXIDES; ELECTROCHEMISTRY

466 (AD--820687) FABRICATION OF ULTRATHIN SOLID ELECTROLYTE BATTERIES. QUARTERLY PROGRESS REPORT NO. 1, 1 APRIL--1 JULY 1967. Vouros, P.; Clune, J.; Masters, J.I. (Technical Operations, Inc., Burlington, Mass. (USA)). Jul 1967. Contract DAAB07-67-C-0339. 19p. (TO-B--67-43).
Pt/AgI/Ag. METAL-METAL BATTERIES;PLATINUM; SILVER;SILVER IODIDES;FILMS;FABRICATION; ELECTRONIC CIRCUITS;ELECTRIC CONTACTS;SILVER BROMIDES

467 (AD--821051) LITHIUM-ANODE LIMITED CYCLE BATTERY INVESTIGATION. FINAL REPORT, 1 JANUARY 1966--1 JUNE 1967. Bauman, H.F.; Chilton, J.E.; Hultquist, A.E. (Lockheed Missiles and Space Co., Palo Alto, Calif. (USA). Lockheed Palo Alto Research Lab.). Jul 1967. Contract AF33(615)-2455. 75p.
Li/$CuF_2$ with $LiClO_4$-propylene carbonate electrolyte, 30 V, 25 Ah, 50 Wh/lb, improved $CuF_2$ utilization. METAL-NONMETAL BATTERIES; LITHIUM;COPPER FLUORIDES;LITHIUM COMPOUNDS; PERCHLORATES;CARBONIC ACID ESTERS;CATHODES; LIFETIME;ELECTRIC CURRENTS;FABRICATION; ELECTROCHEMISTRY;POLARIZATION;ELECTRIC POTENTIAL;PERFORMANCE

468 (AD--821594) FAST-CHARGE POWER SUPPLY. Boyd, D.P.; Comyn, R.H. (Harry Diamond Labs., Washington, D.C. (USA)). Jul 1967. 40p.

(HDL-TR--1354).
Quickly chargeable (<5 s) battery for fuzes for cannons or rockets. LOW TEMPERATURE;MEDIUM TEMPERATURE;SILVER-ZINC BATTERIES;PERFORMANCE; ROCKETS

469 (AD--822442) LITHIUM--CHLORINE ELECTROCHEMICAL ENERGY STORAGE SYSTEM. FINAL TECHNICAL REPORT, 13 DECEMBER 1965--13 MARCH 1967. Powers, J.P. (General Motors Corp., Indianapolis, Ind. (USA). Allison Div.). Contract DA-44-009-AMC-1426(T). 214p.
Attempts to increase charge rate. LITHIUM-CHLORINE BATTERIES;ELECTRIC-POWERED VEHICLES; BATTERY CHARGING;EFFICIENCY;CONFIGURATION; ELECTRODES;FABRICATION;ELECTROCHEMISTRY; PERFORMANCE;POROSITY;COOLING;ADSORPTION; CHEMICAL REACTIONS

470 (AD--822515) ZINC/AIR HIGH-ENERGY-DENSITY RECHARGEABLE ENERGY STORAGE SYSTEM. FINAL REPORT, 6 JANUARY--6 SEPTEMBER 1966. Katsoulis, E.G.; Vertes, M.A.; Alfredson, K. (Leesona Corp., Great Neck, N.Y. (USA). Leesona Moos Labs. Div.). Dec 1966. Contract DA-44-009-AMC-1469(T). 56p.
10 kWh, 83 Wh/lb. ZINC-AIR BATTERIES;HEAT TRANSFER;MASS TRANSFER;COOLING;AIR;WATER; HYDROXIDES;ELECTRIC-POWERED VEHICLES;POTASSIUM HYDROXIDES;ELECTRIC POTENTIAL;ELECTRIC CURRENTS; OXYGEN;OPERATION

471 (AD--823190) SILVER--ZINC MISSILE POWER SUPPLY. QUARTERLY PROGRESS REPORT NO. 9, 30 JUNE--30 SEPTEMBER 1967. Chireau, R.F. (Yardney Electric Corp., New York (USA)). Oct 1967. Contract AF33(615)-2663. 84p.
95 V. MISSILES;SILVER-ZINC BATTERIES;POWER SUPPLIES;HYDROXIDES;DESIGN;PERFORMANCE;DC TO DC CONVERTERS

472 (AD--823304) HIGH ENERGY BATTERIES. FINAL REPORT. Jasinski, R.; Burrows, B.; Malachesky, P. (Tyco Labs., Inc., Waltham, Mass. (USA)). Aug 1967. 177p. NTIS $3.00.
The research concerned (1) lithium batteries based on organic aprotic solvents and (2) aqueous AgO/Zn batteries. Techniques were established for reducing the impurity content of propylene carbonate to 10 ppM. A Li/Li+ reference electrode was developed for use with $LiClO_4$/PC solutions. Thin film Cu/$CuF_2$ electrodes were formed by electroplating in anhydrous HF-KF. The discharge behavior of silver oxide was studied in aqueous KOH. Charge acceptance was a pronounced function of current density for silver and its alloys with Pb, Pd, and Au. Amalgamated silver and gold are satisfactory $O_2$ removal electrodes for AgO/Zn batteries. Hydrogen evolution is of the same order as on zinc. Pre-electrolysis of aqueous KOH will introduce trace impurities into solution if the electrode is allowed to reach $O_2$ evolution.

473 (AD--823679) LITHIUM-MOIST AIR BATTERY. FINAL REPORT, MARCH 1966--JULY 1967. Toni, J.E.A.; Zwaagstra, R.L. (Globe-Union, Inc., Milwaukee, Wis. (USA)). Jul 1967. 39p.
LITHIUM;AIR;METAL-GAS BATTERIES;FEASIBILITY STUDIES;ELECTRIC-POWERED VEHICLES;CATHODES; PERFORMANCE;OXYGEN;AMINES;NITROSO COMPOUNDS; LITHIUM PERCHLORATES;QUATERNARY COMPOUNDS; ORGANIC FLUORINE COMPOUNDS;PHOSPHATES

474 (AD--824398) FABRICATION OF ULTRATHIN SOLID ELECTROLYTE BATTERIES. QUARTERLY PROGRESS REPORT NO. 2, 1 JULY--1 OCTOBER 1967. Vouros, P.; Clune, J.; Masters, J.I. (Technical Operations, Inc., Burlington, Mass. (USA)). Oct 1967. Contract DAAB07-67-C-0339. 18p.
Pt/AgI/Ag, Au/AgBr/Ag, Pt/$KAg_4I_5$/Ag, Ag/AgI/Ag. METAL-METAL BATTERIES;FILMS;LEAKAGE CURRENT; SILVER;FABRICATION;PLATINUM;SILVER IODIDES;GOLD; SILVER BROMIDES;PLATINUM;SILVER IODIDES; POTASSIUM IODIDES;PERFORMANCE

475 (AD--824467) RECHARGEABLE METAL--AIR CELL. QUARTERLY REPORT NO. 1, 1 MAY--31 JULY 1967. Kent, C.E.; Siwek, E.G. (General Electric Co., Schenectady, N.Y. (USA)). Dec 1967. Contract DAAB07-67-C-0257. 56p. (S--67-1183).
Pb/air. DESIGN;CADMIUM-AIR BATTERIES;ZINC-AIR BATTERIES;METAL-GAS BATTERIES;AIR;LEAD; ANODES;EFFICIENCY;CORROSION;GASES

476 (AD--825167) DEVELOPMENT OF ELECTROCHEMICAL ENERGY STORAGE UNIT FOR VEHICLE PROPULSION. FINAL TECHNICAL REPORT, 30 JUNE 1966--30 SEPTEMBER 1967. Anderson, R.A.; Firestone, R.F.; Hacha, T.H.; Rightmire, R.A.; Selover, T.B. Jr. (Standard Oil Co., Cleveland, Ohio (USA)). Dec 1967. 63p.
Li--Al/LiCl--KCl/C, 100 Wh/lb. METAL-NONMETAL BATTERIES;LITHIUM ALLOYS;ALUMINIUM ALLOYS;LITHIUM CHLORIDES;POTASSIUM CHLORIDES; CARBON;HIGH TEMPERATURE;ELECTROCHEMISTRY; ELECTRIC-POWERED VEHICLES;DESIGN

477 (AD--825181) HIGH-ENERGY NONAQUEOUS BATTERY SYSTEM. FINAL REPORT, 1 DECEMBER 1965--31 AUGUST 1967. Eisenberg, M.; Wong, K.K.M. (Electrochimica Corp., Menlo Park, Calif. (USA)). Sep 1967. Contract NOW-66-0342. 122p.
LITHIUM-COPPER CHLORIDE BATTERIES;DESIGN; CHEMICAL REACTION KINETICS;ELECTRODES

478 (AD--826554) NONAQUEOUS ELECTROLYTE SYSTEMS. INTERIM REPORT NO. 2. Bennion, D.N.; Yao, N.P.; D'Orsay, E. (California Univ., Los Angeles (USA). Dept. of Engineering). Sep 1967. Contract DA-44-009-AMC-1661(T). 50p.
Li/Cu fluoride, AgCl, I, or potassium persulfate with $LiClO_4$ electrolyte in tetramethylene sulfoxide or dimethyl sulfite solvent. METAL-NONMETAL BATTERIES;ELECTROLYTES; SOLVENTS;ELECTRIC CONDUCTIVITY;VISCOSITY; DENSITY;TEMPERATURE DEPENDENCE;COPPER FLUORIDES; SILVER CHLORIDES;IODINE;POTASSIUM COMPOUNDS; PERSULFATES;SULFOXIDES;SULFITES;LITHIUM PERCHLORATES

479 (AD--827683) DESIGN OF STANDARD LINE OF VENTED SILVER--ZINC BATTERIES. QUARTERLY REPORT NO. 3, 10 JULY--31 OCTOBER 1967. Hawkins, B.R.; Carr, E. (Eagle-Picher Industries, Inc., Joplin, Mo. (USA). Couples Dept.). Dec 1967. Contract DAAB07-67-C-0216. 23p.
VENTS;DESIGN;SILVER-ZINC BATTERIES;TESTING; LIFETIME

480 (AD--828589) RECHARGEABLE METAL--AIR CELL. QUARTERLY REPORT NO. 2, 1 AUGUST--31 OCTOBER 1967. Hirsch, H.H.; Van der Grinten, W.J.; Carson, W.N.; Moran, P.J. (General Electric Co., Schenectady, N.Y. (USA). Research and Development Center). Feb 1968. Contract DAAB07-67-C-0257. 78p. (S--68-1028).
Pb/air. LEAD;AIR;METAL-GAS BATTERIES; CATHODES;CADMIUM-AIR BATTERIES;DESIGN;ZINC-AIR BATTERIES;ANODES;PERFORMANCE

481 (AD--828612) INVESTIGATION LEADING TO THE DEVELOPMENT OF A SILVER OXIDE--ZINC BATTERY. SUMMARY REPORT NO. 3. Streigle, P.E.; Caples, A.S. (Catalyst Research Corp., Baltimore, Md. (USA)). Dec 1967. 228p.
24 V, 50h operation -65 to +125 F. SILVER-ZINC BATTERIES;SILVER OXIDES;HYDROXIDES;DESIGN; ELECTROLYTES;HEATING;HEAT EXCHANGERS; PERFORMANCE

482 (AD--829289) SURVEY AND ANALYSIS ON METAL--AIR CELLS. TECHNICAL REPORT (FINAL), 20 JANUARY 1966--4 JANUARY 1968. Fleischer, A. (Chemical and Metallurgical Research, Inc., Chattanooga, Tenn. (USA)). Mar 1968. Contract AF33(615)-3527. 85p.
ZINC-AIR BATTERIES;CADMIUM-AIR BATTERIES; METAL-GAS BATTERIES;AIR;IRON;COBALT;NICKEL; ELECTROCHEMISTRY;MATERIALS;ANODES;OXYGEN

483 (AD--829655) FABRICATION OF ULTRATHIN SOLID ELECTROLYTE BATTERIES. QUARTERLY PROGRESS REPORT NO. 3, 1 OCTOBER 1967--1 JANUARY 1968. Vouros, P.; Clune, J.; Masters, J.I. (Technical Operations, Inc., Burlington, Mass. (USA)). Jan 1968. Contract DAAB07-67-C-0339. 18p. (TO-B--68-16).
Au/AgBr/Ag. FILMS;FABRICATION;METAL-METAL BATTERIES;GOLD;SILVER;SILVER BROMIDES;SILVER IODIDES;PLATINUM;ELECTROLYTES;VOIDS;ELECTRIC CONDUCTIVITY

484 (AD--831150) INVESTIGATION OF MAINTENANCE-FREE HIGH-RATE, NICKEL--CADMIUM BATTERIES FOR AIRCRAFT APPLICATION. QUARTERLY TECHNICAL PROGRESS REPORT NO. 7, 1 SEPTEMBER 1967--29 FEBRUARY 1968. Kantner, E.; Lennon, H.J.; Wouk, V.; Gladstone, B. (Gulton Industries, Inc., Metuchen, N.J. (USA)). Mar 1968. Contract AF33(615)-5357. 40p.
NICKEL-CADMIUM BATTERIES;AIRCRAFT;DESIGN; HYDROXIDES;BATTERY CHARGERS;MEDIUM TEMPERATURE; LOW TEMPERATURE;ELECTRONIC CIRCUITS;PERFORMANCE; MAINTENANCE;ELECTRIC FILTERS;LIFETIME

485 (AD--831452) SILVER--ZINC MISSILE POWER SUPPLY. QUARTERLY TECHNICAL PROGRESS REPORT NO. 10, 1 OCTOBER 1967--1 JANUARY 1968. Chireau, R.F. (Yardney Electric Corp., New York (USA)). Jan 1968. Contract AF33(615)-2663. 58p.
95 V, 200 Wh. MISSILES;POWER SUPPLIES;SILVER-ZINC BATTERIES;DESIGN;DC TO DC CONVERTERS; FABRICATION;WEIGHT;SIZE

486 (AD--832005) RESEARCH ON A HIGH-ENERGY NONAQUEOUS BATTERY SYSTEM. QUARTERLY PROGRESS REPORT NO. 2, 1 DECEMBER 1967--29 FEBRUARY 1968. (Electrochimica Corp., Menlo Park, Calif. (USA)). Mar 1968. Contract N00017-68-C-1401. 30p.
Study of components and wet-stand characteristics. LITHIUM-COPPER CHLORIDE BATTERIES;GRIDS;BATTERY SEPARATORS;ELECTROLYTES; PERFORMANCE;HEAT TRANSFER;ELECTRODES;SOLUBILITY; DESIGN;ORGANIC COMPOUNDS

487 (AD--834903) ZINC-AIR HYBRID FUEL CELLS. TECHNICAL INFORMATION REPORT. (Pittsburgh Univ., Washington, D.C. (USA). Research Staff). May 1968. Contract DA-49-186-AMC-214(D). 9p. NTIS $3.00.
ZINC-AIR BATTERIES;RADIO EQUIPMENT POWER SUPPLIES;MILITARY EQUIPMENT;DESIGN;PERFORMANCE

488 (AD--834903) ZINC--AIR HYBRID FUEL CELLS. (Pittsburgh Univ., Washington, D.C. (USA). Research Staff). May 1968. Contract DA-49-186-AMC-214(D). 7p.
24 V, 20 and 48 Ah, 1000 h operation, mechanically rechargeable. ZINC-AIR BATTERIES; RADIO EQUIPMENT POWER SUPPLIES;DESIGN;POTASSIUM HYDROXIDES

489 (AD--836554) LITHIUM--NICKEL FLUORIDE SECONDARY BATTERY INVESTIGATION. FINAL REPORT, 27 APRIL 1966--27 APRIL 1968. Lyall, A.E.; Seiger, H.N.; Orshich, J. (Gulton Industries, Inc., Metuchen, N.J. (USA)). Jul 1968. Contract AF33(615)-3488. 283p.
METAL-NONMETAL BATTERIES;LITHIUM;NICKEL FLUORIDES;CARBONIC ACID ESTERS;HYDROXIDES; POTASSIUM COMPOUNDS;FLUORINE COMPOUNDS; PHOSPHATES;ELECTROLYTES;ELECTRIC CONDUCTIVITY; VISCOSITY;CATHODES;POROSITY;PERFORMANCE; CHEMICAL COMPOSITION;CARBON;TESTING;ELECTRODES

490 (AD--837598) INVESTIGATION OF MAINTENANCE-FREE, HIGH-RATE, NICKEL--CADMIUM BATTERY POWER SYSTEM FOR AIRCRAFT APPLICATION. QUARTERLY TECHNICAL PROGRESS REPORT NO. 8, 1 MARCH--31 MAY 1968. Kantner, E.; Lennon, H.J.; Wouk, V.; Gladstone, B. (Gulton Industries, Inc., Metuchen, N.J. (USA)). Jun 1968. Contract AF33(615)-5357. 60p.
Breadboard circuit tested from -40 to +140 F. NICKEL-CADMIUM BATTERIES;AIRCRAFT;DESIGN;LOW TEMPERATURE;MEDIUM TEMPERATURE;PERFORMANCE; LOGIC CIRCUITS;FUNCTIONAL MODELS;BATTERY CHARGERS

491 (AD--839644) RECHARGEABLE METAL--AIR CELL. QUARTERLY REPORT NO. 3, 1 NOVEMBER 1967--31 JANUARY 1968. Hirsch, H.H.; Van Der Grinten, W.J.; Carson, W.N.; Moran, P.J. (General Electric Co., Schenectady, N.Y. (USA). Research and Development Center). Aug 1968. Contract DAAB07-67-C-0257. 55p. (S--68-1128).
CADMIUM-AIR BATTERIES;ZINC-AIR BATTERIES; TESTING;PERFORMANCE;DESIGN;REDOX REACTIONS

492 (AD--840076) FABRICATION OF ULTRATHIN SOLID ELECTOLYTE BATTERIES. REPORT NO. 4 (FINAL), 1 APRIL 1967--31 MARCH 1968. Vouros, P.; Clune, J.; Masters, J.I. (Technical Operations, Inc., Burlington, Mass. (USA)). Aug 1968. Contract DAAB07-67-C-0339. 48p. (TO-B--68-31).
Ag/Pt or Au with AgI, KI, AgBr, or AgCl electrolyte. FILMS;METAL-METAL BATTERIES; FABRICATION;SILVER;PLATINUM;GOLD;POTASSIUM IODIDES;SILVER IODIDES;SILVER BROMIDES;SILVER CHLORIDES

493 (AD--840290) EVALUATION OF NI--FE AND NI--ZN BATTERIES. SEMIANNUAL REPORT NO. 1, 1 NOVEMBER 1967--30 APRIL 1968. Blickwedel, T.W. (General Telephone and Electronics Labs., Inc., Bayside, N.Y. (USA)). Sep 1968. Contract DAAB07-68-C-0102. 36p.
IRON-NICKEL BATTERIES;NICKEL-ZINC BATTERIES; DESIGN;PERFORMANCE;ELECTRODES;THICKNESS; CONFIGURATION;BATTERY SEPARATORS;ELECTROLYTES; CHEMICAL COMPOSITION;ADDITIVES

494 (AD--840361) 30-WATT LITHIUM HYDRIDE FUEL CELL. (Governmental Affairs Inst., Washington, D.C. (USA). Research Div.). Aug 1968. Contract DAAG39-69-C-0001. 9p.
Hybrid fuel cell--electric battery. LITHIUM HYDRIDES;HYDROGEN FUEL CELLS;HYDROGEN GENERATORS;HYBRID SYSTEMS;POWER RANGE 10-100 W;

ELECTRIC BATTERIES;DESIGN;PERFORMANCE

495 (AD--840560) DESIGN OF STANDARD LINE OF VENTED SILVER--ZINC BATTERIES. ACCEPTANCE TEST REPORT, 10 JUNE 1967--29 FEBRUARY 1968. Hawkins, B.R.; Carr, E.S. (Eagle-Picher Industries, Inc., Joplin, Mo. (USA). Couples Dept.). Sep 1968. 24p.
SCL-6870A. DESIGN;VENTS;SILVER-ZINC BATTERIES;PERFORMANCE;LEAKAGE CURRENT; PERFORMANCE TESTING

496 (AD--841130) DEVELOPMENT OF ELECTROCHEMICAL ENERGY STORAGE UNIT FOR VEHICLE PROPULSION. FINAL TECHNICAL REPORT NO. 3, 3 MARCH 1966--30 JUNE 1968. Sprague, J.W. (Standard Oil Co., Cleveland, Ohio (USA)). 1 Oct 1968. 52p. NTIS.
The purpose of the research was the discovery and development of an economic electrical energy storage system which would propel a vehicle two hundred miles with performance comparable to present automobiles. The lithium-chloride system was selected on the basis of its high energy density. The cell employs an active carbon cathode, a solid lithium-aluminum anode, and molten lithium chloride-potassium chloride electrolyte. The system can operate over a range of temperatures from 355 to 550 C. The specific purpose of the report is to describe the results obtained with cells which exhibited improved packing efficiency, the incorporation of an additive, which significantly enhanced cell performance without apparent undesirable side effects, and the benefits of producing cells under conditions of improved cleanliness.

497 (AD--841130) DEVELOPMENT OF ELECTROCHEMICAL ENERGY STORAGE UNIT FOR VEHICLE PROPULSION. FINAL TECHNICAL REPORT, 3 MARCH 1966--30 JUNE 1968. (Standard Oil Co., Cleveland, Ohio (USA)). Oct 1968. Contract DA-44-009-AMC-1531(T). 51p.
Li--Al/LiCl--KCl/C. ELECTRIC-POWERED VEHICLES;METAL-NONMETAL BATTERIES;DESIGN;CARBON; LITHIUM ALLOYS;ALUMINIUM ALLOYS;LITHIUM CHLORIDES;POTASSIUM CHLORIDES;ADDITIVES; PERFORMANCE

498 (AD--843141) CHEMOELECTRIC ENERGY CONVERSION FOR NONAQUEOUS BATTERIES AND FUEL CELLS. QUARTERLY REPORT NO. 20, APR--JUN 1968. Miles, M.H.; Kellett, P.M.; Harris, W.S.; Bennion, D.N.; Dunning, J.S. (Naval Weapons Center, Corona, Calif. (USA)). [nd]. 50p.
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499 (AD--843245) REVIEW OF SOME MODERN POWER SUPPLIES. King, T.E.; Moroz, W.J.; Lackner, J.L.; Haines, R.L.; Turlock, L.A. (Defence Chemical, Biological and Radiation Establishment, Ottawa, Ontario (Canada)). Aug 1968. 34p.
From 1. meeting of QWG/CCE, Headquarters Mobile Command; St. Hubert, Quebec, Canada (23 Oct 1967).
PERFORMANCE;RELIABILITY;NICKEL-CADMIUM BATTERIES;BATTERY CHARGERS;CONTROL SYSTEMS; HYDROXIDES;FUEL CELLS;METAL-GAS BATTERIES;AIR; SILVER-ZINC BATTERIES;MANGANESE ALLOYS; MAGNESIUM;LITHIUM;SODIUM-SULFUR BATTERIES; LITHIUM-COPPER CHLORIDE BATTERIES;ELECTRIC BATTERIES

500 (AD--843503) DESIGN OF STANDARD LINE OF VENTED SILVER--ZINC BATTERIES. FINAL REPORT, JANUARY 1967--AUGUST 1968. Hawkins, B.R.; Carr, E.S. (Eagle-Picher Industries, Inc., Joplin, Mo. (USA). Couples Dept.). Oct 1968. Contract DAAB07-67-C-0216. 34p.
DESIGN;VENTS;SILVER-ZINC BATTERIES; PERFORMANCE TESTING;HYDROXIDES;OPTIMIZATION

501 (AD--843741) RESEARCH ON A HIGH-ENERGY NONAQUEOUS BATTERY SYSTEM. QUARTERLY PROGRESS REPORT NO. 4, 1 JUNE--31 AUGUST 1968. (Electrochimica Corp., Menlo Park, Calif. (USA)). Sep 1968. Contract N00017-68-C-1401. 27p.
LITHIUM-COPPER CHLORIDE BATTERIES;DESIGN; ELECTRODES;POLARIZATION;GRIDS;CORROSION

502 (AD--845273) ANALYTICAL STUDIES OF THE ENERGY STORAGE PROCESS AT POROUS CARBON ELECTRODES IN MOLTEN SALT ELECTROLYTES. INTERIM TECHNICAL REPORT, 8 MARCH--7 SEPTEMBER 1968. Benak, J.L.; Metcalfe, J.E. III; Sprague, J.W. (Standard Oil Co., Cleveland, Ohio (USA)). Oct 1968. Contract DAAK02-68-C-0253. 34p.
ELECTRIC BATTERIES;ELECTROCHEMISTRY;CARBON; ELECTRODES;MOLTEN SALTS;LITHIUM CHLORIDES;CHARS; GRAPHITE;CHLORINATED ALIPHATIC HYDROCARBONS; POLYVINYLS;ALUMINIUM ALLOYS;LITHIUM ALLOYS; ELECTRIC-POWERED VEHICLES

503 (AD--845913) 12-VOLT-DRY-CHARGED LEAD--ACID BATTERIES. (Governmental Affairs Inst., Washington, D.C. (USA). Research Div.). Nov 1968. Contract DAAG39-69-C-0001. 9p.
45 and 100 Ah. LEAD-ACID BATTERIES;DESIGN; ELECTROLYTES;GELS

504 (AD--845914) VENTED NICKEL--CADMIUM BATTERY, BB-501( )/U. (Governmental Affairs Inst., Washington, D.C. (USA). Research Div.). Nov 1968. Contract DAAG39-69-C-0001. 9p.
NICKEL-CADMIUM BATTERIES;HYDROXIDES;DESIGN; RADIO EQUIPMENT POWER SUPPLIES;CONTAINERS;VENTS

505 (AD--846063) RESEARCH ON ELECTROCHEMICAL ENERGY CONVERSION SYSTEMS. SEMIANNUAL RESEARCH REPORT NO. 5, NOVEMBER 1967--MAY 1968. Foley, R.T.; Taborek, E.J.; Bomkamp, D.H. (American Univ., Washington, D.C.). Nov 1968. Contract DA-44-009-AMC-1386(T). 32p.
METAL-GAS BATTERIES;LITHIUM;AIR;CARBONIC ACID ESTERS;LITHIUM COMPOUNDS;PERCHLORATES; OXYGEN;GASES;EMISSION;ELECTRIC-POWERED VEHICLES; DATA PROCESSING;ELECTRIC BATTERIES;HYBRID ELECTRIC-POWERED VEHICLES;SIMULATION

506 (AD--847080) IMPROVED SILVER--ZINC BATTERIES. (Governmental Affairs Inst., Washington, D.C. (USA). Research Div.). Nov 1968. Contract DAAG39-69-C-0001. 9p.
SILVER-ZINC BATTERIES;DESIGN;SILVER OXIDES; PERFORMANCE;HYDROXIDES

507 (AD--847137) CHEMOELECTRIC ENERGY CONVERSION FOR NONAQUEOUS BATTERIES AND FUEL CELLS. Harris, W.S.; Wilcox, M.; Szpak, S.J.; Daley, J.C.; Hoyt, C.H. (Naval Weapons Center, Corona, Calif. (USA)). [nd]. 63p.
NITROBENZENE;AMIDES;ELECTROCHEMISTRY;FUEL CELLS;CATHODES;LITHIUM;ELECTRODES;LIQUID METALS; AMMONIA;REDUCTION;BERYLLIUM;POROSITY;FLUID MECHANICS;SOLVENTS;LITHIUM COMPOUNDS;

PERCHLORATES;NITRILES;ELECTRIC BATTERIES

508 (AD--848884) RESEARCH ON A HIGH-ENERGY NONAQUEOUS BATTERY SYSTEM. QUARTERLY PROGRESS REPORT NO. 5, 1 SEPTEMBER--30 NOVEMBER 1968. (Electrochimica Corp., Menlo Park, Calif. (USA)). Dec 1968. Contract N00017-68-C-1401. 20p.
LITHIUM-COPPER CHLORIDE BATTERIES;DESIGN; ELECTRODES;ELECTROCHEMISTRY;CHEMICAL REACTIONS; BATTERY SEPARATORS;MATERIALS;CHEMICAL COMPOSITION;CHEMICAL REACTION KINETICS

509 (AD--849009) DEVELOPMENT OF AN IMMOBILIZED-ELECTROLYTE, WATER-ACTIVATED, DRY-CHARGED, LEAD--ACID 6TN STORAGE BATTERY. FINAL REPORT, 29 JUNE 1967--30 AUGUST 1968. Ockerman, J.B.; Biddick, R.E. (Gould-National Batteries, Inc., Minneapolis, Minn. (USA). Research Div.). Sep 1968. Contract DAAE07-67-C-4825. 30p.
LEAD-ACID BATTERIES;GELS;SULFURIC ACID; ELECTROLYTES;FABRICATION;BATTERY SEPARATORS

510 (AD--849828) MANPACK VENTED NICKEL--CADMIUM BATTERIES, BB-500( )/U, BB-607( )/U, AND BB-610( )/U. (Governmental Affairs Inst., Washington, D.C. (USA). Research Div.). Jan 1969. Contract DAAG39-69-C-0001. 10p.
VENTS;NICKEL-CADMIUM BATTERIES;DESIGN;RADIO EQUIPMENT POWER SUPPLIES

511 (AD--849830) IMPROVED 6TNC 12-VOLT NICKEL--CADMIUM BATTERIES. (Governmental Affairs Inst., Washington, D.C. (USA). Research Div.). Jan 1969. Contract DAAG39-69-C-0001. 9p.
KOH electrolyte. NICKEL-CADMIUM BATTERIES; HYDROXIDES;DESIGN;POTASSIUM HYDROXIDES

512 (AD--850292) SECONDARY CADMIUM--AIR CELLS. (Governmental Affairs Inst., Washington, D.C. (USA). Research Div.). Jan 1969. Contract DAAG39-69-C-0001. 11p.
40 to 45 Wh/lb. CADMIUM-AIR BATTERIES;DESIGN; TESTING

513 (AD--853037) RECHARGEABLE METAL--AIR CELL. FINAL REPORT, 1 MAY 1967--30 NOVEMBER 1968. Hirsch, H.H.; Mathewson, W.J.; Moran, P.J.; Ruzzo, J.C.; Siwek, E.G. (General Electric Co., Schenectady, N.Y. (USA). Research and Development Center). Apr 1969. Contract DAAB07-67-C-0257. 85p.
Study of Cd, Pb, and Zn anodes. METAL-GAS BATTERIES;AIR;RADIO EQUIPMENT POWER SUPPLIES; COMPARATIVE EVALUATIONS;PLANNING;LOW TEMPERATURE;MEDIUM TEMPERATURE;ANODES;ZINC; CADMIUM;HYDROXIDES;ZINC OXIDES;AMMONIUM HYDROXIDES;POTASSIUM HYDROXIDES;LEAD;INORGANIC ACIDS

514 (AD--853976) RESEARCH ON A HIGH-ENERGY NONAQUEOUS BATTERY SYSTEM. QUARTERLY PROGRESS REPORT NO. 6, 1 DECEMBER 1968--28 FEBRUARY 1969. (Electrochimica Corp., Menlo Park, Calif. (USA)). Mar 1969. Contract N00017-68-C-1401. 43p.
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515 (AD--854368) LITHIUM BATTERY RESEARCH. ANNUAL REPORT NO. 1, 1 APRIL 1968--31 MARCH 1969. Semones, D.E.; Tidwell, T.; McCallum, J. (Battelle Columbus Labs., Ohio (USA)). Jun 1969. Contract F33615-68-C-1282. 87p.
Li/halide, most promising were AgF, $CuF_2$ and $CdCl_2$. METAL-NONMETAL BATTERIES;ELECTROLYTES; CARBONIC ACID ESTERS;LITHIUM;HALIDES;CATHODES; PERFORMANCE TESTING;CHLORIDES;LACTONES;SILVER FLUORIDES;CESIUM FLUORIDES;COPPER FLUORIDES; CADMIUM CHLORIDES;MAGNESIUM CHLORIDES;LITHIUM CHLORIDES

516 (AD--856423) RESEARCH ON A HIGH-ENERGY NONAQUEOUS BATTERY SYSTEM. QUARTERLY PROGRESS REPORT NO. 7, 1 MARCH--31 MAY 1969. (Electrochimica Corp., Menlo Park, Calif. (USA)). Jun 1969. Contract N00017-68-C-1401. 34p.
PERFORMANCE;DESIGN;TESTING;ELECTROCHEMISTRY; POLYPROPYLENE;LITHIUM-COPPER CHLORIDE BATTERIES; CATHODES;CHEMICAL COMPOSITION;BATTERY SEPARATORS;ANODES;GRIDS;CHEMICAL REACTIONS; HEATING;ELECTROLYTES;ELECTRODES

517 (AD--859743) SEMIANNUAL PROGRESS REPORT NO. 2, 1 JANUARY--30 JUNE 1969. Burton, R.W. (Air Force Academy, Colo. (USA)). Jul 1969. 37p.
U. S. Air Force Academy faculty research in many fields. PERSONNEL;MANAGEMENT;ELECTRIC BATTERIES;WELDING;COST;ENGINEERING;RESEARCH PROGRAMS

518 (AD--860708) MAINTENANCE-FREE SILVER--CADMIUM BATTERIES FOR AIRCRAFT EMERGENCY APPLICATIONS. TECHNICAL REPORT NO. 8 (FINAL), JUNE 1965--AUGUST 1969. Dalin, G. (Yardney Electric Corp., New York (USA)). Aug 1969. Contract AF33(615)-2615. 92p.
SILVER-CADMIUM BATTERIES;POWER CONDITIONING CIRCUITS;AIRCRAFT;ACCIDENTS;HYDROXIDES;DESIGN; RELIABILITY;BATTERY CHARGING;HEATERS

519 (AD--861947) ADVANCED DESIGN BATTERY POWER SOURCE FOR AIRCREW SURVIVAL TRANSCEIVERS AND BEACONS. INTERIM TECHNICAL REPORT, MARCH 1968--AUGUST 1969. Chand, R.; Smith, D.A. (Whittaker Corp., San Diego, Calif. (USA)). Oct 1969. Contract F33657-68-C-0438. 102p.
Screening of Li/$CdF_2$, Li/$ZnF_2$, and Li/Ag sulfide couples. RADIO EQUIPMENT POWER SUPPLIES; HYDROXIDES;BATTERY SEPARATORS;ELECTROLYTES;HEAT TREATMENTS;ELECTRIC CONDUCTIVITY;QUALITY CONTROL;PLANNING;METAL-NONMETAL BATTERIES; LITHIUM;CADMIUM FLUORIDES;ZINC FLUORIDES;SILVER SULFIDES

520 (AD--863071) RESEARCH ON ELECTROCHEMICAL ENERGY CONVERSION SYSTEMS. INTERIM TECHNICAL REPORT NO. 7, NOVEMBER 1968--MAY 1969. Foley, R.T.; Bomkamp, D.H. (American Univ., Washington, D.C.). Jul 1969. Contract DA-44-009-AMC-1386(T). 28p.
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521 (AD--865063) HIGH INTENSITY TACTICAL POWER SOURCES FOR THE 1990 ARMY. FINAL REPORT. (Army Advanced Material Concepts Agency, Alexandria, Va. (USA)). Jan 1970. 52p. (AMCA--70-002). NTIS.
100 kW to multi-MW. MILITARY EQUIPMENT; ELECTRIC POWER;MHD GENERATORS;NUCLEAR POWER PLANTS;SOLAR CELLS;THERMOELECTRIC GENERATORS; THERMIONIC CONVERTERS;FUEL CELLS;ELECTRIC BATTERIES;EHD GENERATORS;POWER SUPPLIES; FORECASTING;POWER RANGE 100-1000 KW;POWER RANGE 1-10 MW;POWER RANGE 10-100 MW

522 (AD--865063) HIGH-INTENSITY TACTICAL POWER SOURCES FOR THE 1990 ARMY. FINAL REPORT. (Army Advanced Material Concepts Agency, Alexandria, Va. (USA)). Jan 1970. 52p.
POWER GENERATION;COMPARATIVE EVALUATIONS;MHD GENERATORS;NUCLEAR POWER PLANTS;ENERGY CONVERSION;CAPACITORS;SOLAR CELLS; THERMOELECTRICITY;THERMIONIC CONVERTERS;FUEL CELLS;ELECTRIC BATTERIES;THERMOELECTRIC GENERATORS;EHD GENERATORS;DIRECT ENERGY CONVERTERS

523 (AD--868205) REVIEW 1969. (Defence Research Board of Canada, Ottawa, Ontario). 1969. 88p.
Defence Research Board, Ottawa. ELECTRIC BATTERIES;RESEARCH PROGRAMS;FLUID MECHANICS; LASERS;UNDERWATER;SOUND WAVES;EXPLOSIONS; SATELLITES;PROTECTIVE CLOTHING;ARCTIC REGIONS; PHYSIOLOGY;RADIATION DOSES;CORROSION

524 (AD--868947) RESEARCH ON ELECTROCHEMICAL PARAMETERS FOR NONAQUEOUS BATTERIES: TASK 1. QUARTERLY PROGRESS REPORT NO. 1. (Electrochimica Corp., Menlo Park, Calif. (USA)). Jan 1970. 32p.
Li--Al/$AlCl_3$--LiCl/$CuCl_2$. METAL-NONMETAL BATTERIES;LITHIUM;ALUMINIUM CHLORIDES;LITHIUM CHLORIDES;COPPER CHLORIDES;ANODES;STABILITY; POLARIZATION;HEAT TRANSFER;BATTERY SEPARATORS; ELECTROCHEMISTRY;DESIGN;NITRO COMPOUNDS

525 (AD--870181) RESEARCH ON ELECTROCHEMICAL PARAMETERS FOR NONAQUEOUS BATTERIES: TASK I. QUARTERLY PROGRESS REPORT NO. 2. (Electrochimica Corp., Menlo Park, Calif. (USA)). Apr 1970. Contract N00017-68-C-1401. 24p.
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526 (AD--870688) LITHIUM BATTERY RESEARCH. ANNUAL REPORT NO. 2, 1 APRIL 1969--31 MARCH 1970. Semones, D.E.; Tidwell, T.H.; McCallum, J. (Battelle Columbus Labs., Ohio (USA)). Jun 1970. Contract F33615-68-C-1282. 99p.
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527 (AD--870799) ELECTROCHEMISTRY OF INTERHALOGEN CATHODES. FINAL REPORT, 21 APRIL 1969--21 MARCH 1970. Nicholson, M.M. (Atomics International Div., Canoga Park, Calif. (USA)). May 1970. Contract N00019-69-C-0456. 54p. (AI--70-21).
Li/$ClF_3$ in NaF--HF electrolyte, theoretical 2120 Wh/lb. METAL-GAS BATTERIES;CHLORINE FLUORIDES;ELECTROCHEMISTRY;CATHODES;LITHIUM; ALKALI METAL COMPOUNDS;FLUORIDES;SODIUM FLUORIDES;HYDROFLUORIC ACID;AMMONIA

528 (AD--873119) DEVELOPMENT OF LOWER COST NICKEL--ZINC BATTERIES. REPORT NO. 1 (FINAL), FEBRUARY 1969--MAY 1970. Popat, P.V. (Texas Instruments, Inc., Attleboro, Mass. (USA)). Jul 1970. Contract DAAB07-69-C-0172. 35p.
9.5 Ah/$in.^3$. NICKEL-ZINC BATTERIES;DESIGN; HYDROXIDES;ELECTRODES;RELIABILITY;COST;LIFETIME

529 (AD--873240) RESEARCH ON ELECTROCHEMICAL ENERGY CONVERSION SYSTEMS. INTERIM TECHNICAL REPORT NO. 8, MAY--NOVEMBER 1969. Foley, R.T.; Bomkamp, D.H.; Thompson, C.D. (American Univ., Washington, D.C.). Jul 1970. Contract DA-44-009-AMC-1386(T). 41p.
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530 (AD--874598) RESEARCH ON ELECTROCHEMICAL PARAMETERS FOR NONAQUEOUS BATTERIES: TASK I. QUARTERLY PROGRESS REPORT NO. 3. (Mallory (P.R.) and Co., Inc., Burlington, Mass. (USA)). Jul 1970. Contract N00017-68-C-1401. 25p.
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531 (AD--876484) TWO-KILOWATT LONG-LIFE BATTERY. FINAL TECHNICAL DOCUMENTARY REPORT, 1 JANUARY 1969--31 JULY 1970. Scott, W.R. (Army Electronics Command, Fort Monmouth, N.J. (USA)). Sep 1970. Contract F33615-69-C-1291. 234p.
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532 (AD--876828) LITHIUM/SELENIUM SECONDARY CELLS FOR COMPONENTS IN ELECTRIC VEHICULAR PROPULSION GENERATING SYSTEMS. INTERIM TECHNICAL SUMMARY REPORT NO. 2, 23 NOVEMBER 1969--22 MAY 1970. Cairns, E.J.; Gay, E.C.; Kolba, V.M.; Kyle, M.L.; Tevebaugh, A.D. (Argonne National Lab., Ill. (USA)). Jun 1970. 97p.
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533 (AD--880894) LITHIUM/CALCOGEN SECONDARY CELLS FOR COMPONENTS IN ELECTRIC VEHICULAR PROPULSION GENERATING SYSTEMS. INTERIM TECHNICAL SUMMARY REPORT NO. 3, 23 MAY--22 NOVEMBER 1970. Cairns, E.J.; Gay, E.C.; Kyle, M.L.; Tevebaugh, A.D.; Trevorrow, L.E. (Argonne National Lab., Ill. (USA)). Nov 1970. 72p. (ANL--7777).
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534 (AD--885799) TWO-KILOWATT LONG-LIFE BATTERY. INTERIM TECHNICAL REPORT NO. 1, 15 JUNE 1970--15 MAY 1971. Stager, D.N.; Scott, W.R.; Zerbel, D.W.; Haugen, H.E.; Layte, H.L. (TRW Systems Group, Redondo Beach, Calif. (USA)). Jun 1971. Contract F33615-70-C-1627. 326p.
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535 (AD--894970L) ALKALINE ZINC--AIR STORAGE BATTERY. Hladik, O. (Army Foreign

Science and Technology Center, Charlottesville, VA). 1972. 7p. (FSTC-HT--23-683-72). DDC.
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536 (AD--900475L) MANUFACTURING METHODS AND TECHNOLOGY MEASURE FOR NICKEL--ZINC SECONDARY BATTERIES. QUARTERLY REPORT NO. 3, 1 JAN-31 MAR 1972. Giltner, L.J. (Eagle-Picher Industries, Inc., Joplin, Mo. (USA). Couples Dept.). May 1972. Contract DAAB05-71-C-2640. 28p. DDC.
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537 (AD--902570L) LOW EARTH ORBIT BATTERY DEVELOPMENT PROJECT. FINAL REPORT, 1 JUL 1970-30 JUN 1972. Levy, E., Jr.; Duncan, E.C.; Maiden, C.E.; Michel, W.E.; Cardwell, G.I. (Hughes Aircraft Co., El Segundo, Calif. (USA)). Jun 1972. Contract AF33615-70-C-1710. 321p. (SCG--20308R; AFAPL-TR--72-60). DDC.
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538 (AD--902749L) MANUFACTURING METHODS AND TECHNOLOGY MEASURE FOR NICKEL--ZINC SECONDARY BATTERIES. QUARTERLY REPORT NO. 4, 1 APR-30 JUN 1972. Giltner, L.J. (Eagle-Picher Industries, Inc., Joplin, Mo. (USA). Couples Dept.). Aug 1970. Contract DAAB05-71-C-2640. 24p. DDC.
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539 (AD--903861L) RESEARCH AND DEVELOPMENT OF A DC--DC CONVERTER. FINAL REPORT, 1 JUN 1971--31 JUL 1972. (INCLUDES SUPPLEMENT). Lingle, J.T. (Honeywell, Inc., Hopkins, Minn. (USA)). Sep 1972. Contract DAAB07-71-C-0223. 101p. (ECOM--0223-F). DDC.
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543 (AD--907704) LITHIUM BATTERY WITH INORGANIC ELECTROLYTE. QUARTERLY PROGRESS REPORT NO. 3, 1 MAY-31 JUL 1972. Auborn, J.J.; French, K.; Heller, A.; Lieberman, S. (GTE Labs., Inc., Waltham, Mass. (USA)). Feb 1973. Contract DAAB07-72-C-0060. 27p. (TR--72-845.3; ECOM--0060-3). NTIS.
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544 (AD--908263L) COBALT--MG, THE POWER INJECTION FOR YOUR BATTERY. (Army Foreign Science and Technology Center, Charlottesville, VA). May 1972. 2p. (FSTC-HT--23-1612-72). DDC.
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545 (AD--908765L) DESIGN AND DEVELOPMENT OF HIGH CHARGE RATE NICKEL CADMIUM BATTERIES. INTERIM PROGRESS REPORT OCT 1970-NOV 1972. Scardaville, P. (Marathon Battery Co., Waco, Tex. (USA)). Mar 1973. Contract DAAB07-70-C-0150. 38p. (ECOM--0150-2). DDC.
NICKEL-CADMIUM BATTERIES;PERFORMANCE; IMPEDANCE;ELECTRODES;ELECTRIC POTENTIAL;DESIGN; FABRICATION;TESTING;SEALS

546 (AD--908970L) MANUFACTURING METHODS AND TECHNOLOGY MEASURE FOR NICKEL--ZINC SECONDARY BATTERIES. QUARTERLY REPORT NO. 6, 1 OCT-31 DEC 1972. Giltner, L.J. (Eagle-Picher Industries, Inc., Joplin, Mo. (USA). Couples Dept.). Aug 1970. Contract DAAB05-71-C-2640. 20p. DDC.
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547 (AD--909450L) DEVELOPMENT OF THE HOLLOW FIBER SODIUM--SULFUR BATTERY. QUARTERLY PROGRESS REPORT 14 OCT 1971-14 JAN 1972. Levine, C.A.; Taplin, W.H.; Tsang, F.Y.; Brown, W.E. (Dow Chemical U.S.A., Walnut Creek, Calif.). Jan 1972. Contract N00298-72-C-0028. 27p. DDC.
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PERFORMANCE;PLANNING

548 (AD--909939L) LATEST TRENDS IN THE BATTERY MANUFACTURING FIELD IN JAPAN. Toshio, I.; Keiichi, S. (Army Foreign Science and Technology Center, Charlottesville, VA). Dec 1972. 24p. (FSTC-HT--23-762-72). DDC.
Translation of Denki Kagaku Oyobi Kogyo Butsuri Kagaku (Japan), 39: No. 7, 605-12(Jul 1971).
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549 (AD--910396L) BA-530( )/U MECHANICALLY RECHARGEABLE ZINC--AIR BATTERY. FINAL REPORT, MAY 1970-FEB 1973. Erisman, L.R. (Eagle-Picher Industries, Inc., Joplin, Mo. (USA). Couples Dept.). May 1973. Contract DAAB07-70-C-0207. 85p. (ECOM--0207-F-70). DDC.
ZINC-AIR BATTERIES;CATHODES;ANODES;COPPER; ELECTROCHEMISTRY;TESTING;PERFORMANCE;LOW TEMPERATURE;MEDIUM TEMPERATURE;LIFETIME

550 (AD--912804) ELECTRICAL POWER SOURCES COMMUNICATIONS AND SPECIAL EQUIPMENT FOR CANADIAN FORCES; BATTERIES FOR CANADIAN SATELLITES. QUARTERLY PROGRESS NOTES, 1 APR-30 JUN 1973. (Defence Research Establishment, Ottawa, Ontario (Canada)). Aug 1973. 46p. NTIS.
POWER SUPPLIES;CANADA;ELECTRIC BATTERIES; FUEL CELLS;MILITARY EQUIPMENT;RESEARCH PROGRAMS; SATELLITES

551 (AD--912804) QUARTERLY PROGRESS NOTES, 1 APR-30 JUN 1973. (Defence Research Establishment, Ottawa, Ontario (Canada)). 46p. NTIS.
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ELECTROCHEMISTRY;FUEL CELLS;ELECTRIC BATTERIES; ELECTROLYTES;NICKEL;ZINC;CADMIUM;SALTS;MELTING; SOLIDS;SILVER COMPOUNDS;OXIDES;CHLORIDES;LEAD COMPOUNDS;MANGANESE COMPOUNDS;SEAWATER; SATELLITES;VEHICLES;RADIO EQUIPMENT POWER SUPPLIES;LOW TEMPERATURE;RESEARCH PROGRAMS; CANADA

552 (AD--913104) MINIATURE SEALED NICKEL--CADMIUM BATTERIES. FINAL REPORT MAR 71--JUN 72. Menard, C.J.; Walsh, J.R.; Kohl, K.C. (Gould, Inc., Mendota Heights, Minn. (USA)). Jun 1973. Contract DAAB07-71-C-0127. 53p. NTIS $4.50.
The purpose of this program has been to design, develop, fabricate, and test miniature high-rate sealed nickel--cadmium batteries of the button cell construction. The battery types are BB-683( )/U (50mAh), BB-684( )/U (100mAh), BB-685( )/U (150mAh), and BB-686( )/U (250mAh). The program was carried out as follows: design parameter study to select prototype models, qualification tests on the prototype batteries in accordance with the specification SCL-6899A, fabrication, and delivery of 100 cells and 20 12-volt batteries of each type. Within the cell dimension and weight limits imposed, the selection of the prototype batteries included investigations on two basic design assemblies; i.e., a 2-plate design and a 4-plate design. The prototype design for the 50 mAh battery is the 2-plate construction; i.e., one positive and one negative. The other three types are of the 4-plate construction; i.e., two positives and two negatives. The four prototype designs met all the requirements (dimensions, weights, electrical, and other environmental tests). The weights of the three 4-plate batteries (100, 150, and 250 mAh sizes) were 8.3, 10.3, and 14.3 g compared to the requirements of 11.34, 12.76, and 17.01 g maximum. In general, the minimum capacity requirements were easily exceeded. Batteries of each type are on long life cycle test. The batteries have passed the minimum 56 cycles that was required before the fabrication of the delivery items. The qualification test results show that the program was successfully accomplished. (auth)

553 (AD--913197L) MANUFACTURING METHODS AND TECHNOLOGY MEASURE FOR NICKEL--ZINC SECONDARY BATTERIES. QUARTERLY REPORT NO. 8, 1 APR-30 JUN 1973. Giltner, L.J. (Eagle-Picher Industries, Inc., Joplin, Mo. (USA). Couples Dept.). Jun 1973. Contract DAAB05-71-C-2640. 16p. (ECOM--2640-8-71). DDC.
NICKEL-ZINC BATTERIES;FABRICATION;ELECTRODES; QUALITY CONTROL;INSPECTION;LIFETIME;TESTING; PERFORMANCE

554 (AD--913308L) CONCEPTUAL DESIGN OF A 164-KW LITHIUM SEAWATER POWER SYSTEM. QUARTERLY TECHNICAL PROGRESS REPORT NO. 2, 5 JUN-4 SEP 1973. (Lockheed Missiles and Space Co., Palo Alto, Calif. (USA). Research Labs.). Sep 1973. Contract N00017-73-C-4311. 37p. (LMSC--D354240). DDC.
LITHIUM;SEAWATER;ELECTRIC BATTERIES;LITHIUM COMPOUNDS;HYDROXIDES;PERFORMANCE;CONFIGURATION; DESIGN

555 (AD--914149L) BA-525( )/U AND BA-526( )/U MECHANICALLY RECHARGEABLE ZINC/AIR BATTERIES. FINAL REPORT. Seidman, S. (Yardney Electric Corp., Pawcatuck, Conn. (USA)). Sep 1973. Contract DAAB07-69-C-0274. 91p. (ECOM--0274-F-69). DDC.
ZINC-AIR BATTERIES;ELECTROLYTES;LIFETIME; WEIGHT;DESIGN;ANODES;CATHODES;SPECIFICATIONS; HEATERS;FABRICATION;TESTING

556 (AD--915855L) DEVELOPMENT OF THE BB-520( )/U NICKEL--CADMIUM BATTERY FOR HYBRID APPLICATIONS. SEMI-ANNUAL REPORT NOV 1972--MAY 1973. Hawkins, B.R.; Miller, L.E. (Eagle-Picher Industries, Inc., Joplin, Mo. (USA). Couples Dept.). Nov 1973. Contract DAAB07-73-C-0070. 37p. (ECOM--0070-S-73). DDC.
NICKEL-CADMIUM BATTERIES;PRIMARY-SECONDARY HYBRID BATTERIES;FABRICATION;PERFORMANCE; ELECTRONIC CIRCUITS;WEIGHT;CONTAINERS;EPOXIDES; CONTROL SYSTEMS;THERMOELECTRIC GENERATORS;FUEL CELLS

557 (AD--915962) QUARTERLY PROGRESS NOTES, 1 JUL 1973--30 SEP 1973. (Defence Research Establishment, Ottawa, Ontario (Canada)). Dec 1973. 49p. NTIS.
Defence Research Establishment, Ottawa.
ELECTRIC BATTERIES;MANAGEMENT;FUEL CELLS;NICKEL-CADMIUM BATTERIES;LEAD-ACID BATTERIES; ELECTROCHEMISTRY;CATALYSTS;AIRCRAFT;SPACE VEHICLES;SATELLITES;SEAWATER;WIND;MOLTEN SALTS; ELECTRIC POWER;RESEARCH PROGRAMS

558 (AD--915962) ELECTRICAL POWER SOURCES COMMUNICATIONS AND SPECIAL EQUIPMENT FOR CANADIAN FORCES; BATTERIES FOR CANADIAN SATELLITES. QUARTERLY PROGRESS NOTES, 1 JUL-30 SEP 1973. (Defence Research Establishment, Ottawa, Ontario (Canada)). Dec 1973. 49p. NTIS.
CANADA;POWER SUPPLIES;ELECTRIC BATTERIES;

FUEL CELLS;THERMAL BATTERIES;RESEARCH PROGRAMS; SATELLITES

559 (AD--917235L) DESIGN AND DEVELOPMENT OF HIGH CHARGE RATE NICKEL--CADMIUM BATTERIES. FINAL REPORT, MAR 1970-NOV 1973. Scardaville, P. (Marathon Battery Co., Waco, Tex. (USA)). Dec 1973. Contract DAAB07-70-C-0150. 48p. (ECOM--0150-F-73). DDC.
BB-478 ( )/U, F size, 1.2 V, 6.3 A-h. NICKEL-CADMIUM BATTERIES;FABRICATION;BATTERY CHARGERS; SEALS;IMPEDANCE;ELECTRIC POTENTIAL;ELECTRODES; THERMODYNAMIC PROPERTIES;HIGH TEMPERATURE;LOW TEMPERATURE;LIFETIME;DESIGN;TESTING

560 (AD--917525L) DEVELOPMENT OF THE 12TN 24 VOLT STORAGE BATTERY. FINAL REPORT, MAY 1972--FEB 1974. (Prestolite Co., Toledo, Ohio (USA)). Feb 1974. Contract DAAE07-72-C-0284. 35p. (TACOM-TR--11849). DDC.
LEAD-ACID BATTERIES;LIFETIME;SPECIFICATIONS; ELECTRICAL PROPERTIES;VEHICLES

561 (AD--917663L) R AND D FOR HYBRID BATTERY AND CELL STUDIES. INTERIM REPORT, 1 APR-1 OCT 1973. Christianson, C.C.; Menard, C.J.; Rubischko, R.J.; Thimmesch, D.M. (Gould, Inc., St. Paul, Minn. (USA). Energy Research Lab.). Feb 1974. Contract DAAB07-73-C-0127. 98p. DDC.
ZINC-AIR BATTERIES;PERFORMANCE;PRIMARY-SECONDARY HYBRID BATTERIES;LIFETIME;ORGANIC COMPOUNDS;MERCURY OXIDES;GALVANOMETERS;LITHIUM; ZINC;MANGANESE OXIDES;ZINC ALLOYS;LITHIUM ALLOYS;MAGNESIUM ALLOYS;TEMPERATURE DEPENDENCE; ELECTRIC CURRENTS;ELECTRIC POTENTIAL; POLARIZATION;ELECTRIC CONDUCTIVITY;LOW TEMPERATURE;SEALS;NICKEL-CADMIUM BATTERIES; BATTERY SEPARATORS;NYLON

562 (AD--917874L) TWO KILOWATT LONG LIFE BATTERY. INTERIM TECHNICAL REPORT NO. 3, 15 SEP 1972-15 SEP 1973. Goldsmith, P.; Scott, W.R.; Robertson, L.G.; Zerbel, D.W.; Clausen, O.W. (TRW Systems Group, Redondo Beach, Calif. (USA)). Dec 1973. Contract F33615-70-C-1627. 107p. (AFAPL-TR--73-117). DDC.
NICKEL-CADMIUM BATTERIES;SATELLITES; RADIATION HARDENING;ELECTRODES;OXYGEN;HEAT PIPES;FAILURES;LIFETIME;TESTING;ELECTRIC CHARGES;CONTROL SYSTEMS;DESIGN

563 (AD--918965L) DEVELOPMENT TEST II (ENGINEERING PHASE) OF ZINC--AIR BATTERY BA-536( )/U. FINAL REPORT, AUG 1973--JAN 1974. Bargo, C. (Army Electronic Proving Ground, Fort Huachuca, Ariz. (USA)). Mar 1974. 68p. (USAEPG-FR--623). DDC.
ZINC-AIR BATTERIES;PERFORMANCE;HIGH TEMPERATURE;LOW TEMPERATURE;TESTING;MECHANICAL VIBRATIONS;DIELECTRIC MATERIALS;ELECTROLYTES; POTASSIUM HYDROXIDES;RADIO EQUIPMENT POWER SUPPLIES;SAFETY;PERFORMANCE TESTING

564 (AD--922405) QUARTERLY PROGRESS NOTES, 1 APRIL 1974--30 JUNE 1974. (Defence Research Establishment, Ottawa, Ontario (Canada)). Aug 1974. 71p.
Research progress on low temperature primary batteries, sea-water batteries, other primaries, low temperature lead/acid batteries, Ni/Cd batteries, fuel cell systems, other secondaries, Ni/Cd aircraft batteries, and fuze batteries is reported.

565 (AD/A--000103) HIGH-ENERGY-DENSITY SINTERED PLATE-TYPE NICKEL--CADMIUM BATTERY CELLS. PART I. THE POSITIVE ELECTRODE/PLAQUE RELATIONSHIP. INTERIM REPORT, DECEMBER 1972--DECEMBER 1973. Seiger, H.N.; Pickett, D.F.; Puglici, V.J.; Ritterman, P.F.; Oliver, R.L. (Heliotek, Sylmar, Calif. (USA)). Aug 1974. Contract F33615-73-C-2012. 23p. (AFAPL-TR--74-56-PT-1). NTIS $3.25.
Work toward cells of 20 W-hr/lb and 2 W-hr/in$^3$. NICKEL-CADMIUM BATTERIES;CATHODES; ELECTROCHEMISTRY;POROSITY;NICKEL HYDROXIDES; DESIGN;NICKEL;IMPREGNATION;FABRICATION;SPACE VEHICLES

566 (AD/A--000417) ANALYSIS OF A COOLING CONCEPT FOR HIGH-DISCHARGE-RATE PILE-TYPE BATTERIES. TECHNICAL REPORT, MARCH--SEPTEMBER 1973. Fritts, D.H. (Air Force Aero-Propulsion Lab., Wright-Patterson AFB, Ohio (USA)). Jul 1974. 40p. (AFAPL-TR--10). NTIS $3.75.
ELECTRIC BATTERIES;FEASIBILITY STUDIES; COOLING;THERMAL ANALYSIS;HEAT SINKS;DESIGN; PERFORMANCE

567 (AD/A--000845) HIGH-POWER LITHIUM--ORGANIC ELECTROLYTE--CF CELL. Higgins, R.L. (Eagle-Picher Industries, Inc., Joplin, Mo. (USA). Couples Dept.). 1974. 133p. NTIS.
LITHIUM;ELECTRIC BATTERIES;ORGANIC COMPOUNDS; ELECTROLYTES;CATHODES;ANODES;BATTERY SEPARATORS; DESIGN;PERFORMANCE

568 (AD/A--002566) VENTED NICKEL--CADMIUM BATTERY ASSEMBLY, BB-651( )/U. Hill, J.M. (Eagle-Picher Industries, Inc., Colorado Springs, Colo. (USA). Precision Products Dept.). 1974. 102p. NTIS.
24 V and 5.5 A-hr or 12 V and 11 A-hr. NICKEL-CADMIUM BATTERIES;VENTS;DESIGN;TESTING; CONTAINERS;ACRYLONITRILE;BUTADIENE;STYRENE; MECHANICAL VIBRATIONS;IMPACT SHOCK

569 (AD/A--002701) SULFUR-BASED LITHIUM--ORGANIC ELECTROLYTE SECONDARY BATTERIES. QUARTERLY REPORT NO. 2, MARCH 3--JUNE 3, 1974. Holleck, G.L.; Brummer, S.B.; Turchan, M.J.; Ross, C.B.; Shuker, F.S. (Army Electronics Command, Fort Monmouth, N.J. (USA)). Dec 1974. Contract DAAB07-74-C-0072. 55p. (ECOM--74-0072-2). NTIS $4.25.
LITHIUM-SULFUR BATTERIES;ORGANIC COMPOUNDS; ELECTROLYTES;FEASIBILITY STUDIES;LITHIUM; TRANSITION ELEMENT COMPOUNDS;SULFUR;SULFIDES; SOLUBILITY;DMSO;CHEMICAL PREPARATION; PERFORMANCE;CATHODES;ELECTROCHEMISTRY;NIOBIUM COMPOUNDS;TITANIUM COMPOUNDS

570 (AD/A--003309) SULFUR-BASED LITHIUM--ORGANIC ELECTROLYTE SECONDARY BATTERIES. QUARTERLY REPORT NO. 3, 4 JUNE--3 SEPTEMBER 1974. Holleck, G.L.; Brummer, S.B.; Shuker, F.S. (Eic, Inc., Newton, Mass. (USA)). Dec 1974. Contract DAAB07-74-C-0072. 43p. (ECOM--74-0072-3). NTIS $3.75.
Li/organic electrolyte/Nb, Ti, V sulfides. METAL-NONMETAL BATTERIES;LITHIUM;ORGANIC COMPOUNDS;ELECTROLYTES;LOW TEMPERATURE;MEDIUM TEMPERATURE;NIOBIUM SULFIDES;TITANIUM SULFIDES; TITANIUM SULFIDES;VANADIUM SULFIDES;OPERATION; PERFORMANCE;CHEMICAL REACTIONS;ELECTRODES; ELECTROCHEMISTRY;FEASIBILITY STUDIES

571 (AD/A--005079) LOW POWER METAL HYDRIDE FUEL CELL/BATTERY HYBRID SYSTEMS. FINAL REPORT, 15 JUNE 1973--15 OCTOBER 1974. Baker, B.S. (Energy Research Corp., Bethel, Conn. (USA)). Jan 1975. Contract DAAB07-73-C-0227. 49p. NTIS $3.75.

HYDROGEN FUEL CELLS;HYDROGEN PEROXIDE; CALCIUM HYDRIDES;DC TO DC CONVERTERS;NICKEL-CADMIUM BATTERIES;HYBRID SYSTEMS;HYDROGEN STORAGE;DESIGN;PERFORMANCE TESTING

572 (AD/A--006427) NICKEL HYDROGEN ENERGY STORAGE FOR SATELLITES. FINAL REPORT, 1 JUL 1973-31 OCT 1974. Levy, E. Jr.; Rogers, H.H.; McGrath, R.J.; Wittmann, A. (Hughes Aircraft Co., El Segundo, Calif. (USA)). Nov 1974. Contract F33615-73-C-2064. 233p. NTIS $7.50.

Work was performed over a 15 month period toward development of lightweight, multiorbit energy storage systems for satellites. The program objective was to use the inherent advantages of nickel-hydrogen cells such as higher energy density, longer life, use of pressure for charge indication and charge control, and tolerance for overcharge and overdischarge. A secondary objective was to investigate the use of a common system or common module for both low and synchronous orbit satellites. This was an exploratory development program to define critical design problems and initiate solutions. The program included subcontracting 50 A-hr cells, both boiler plate and lightweight; performing parametric and cycle tests; analyzing thermal, structural, and electrochemical performance; pressure vessel material studies and material tests; and integrating the cells into spacecraft. The study and test program resulted in a recommended design of a 50 A-hr cell with an estimated flight weight of 2.75 pounds. (GRA)

573 (AD/A--006548) PRODUCTION AND ENGINEERING METHODS FOR CARB-TEK (TRADE NAME) BATTERIES IN FORK-LIFT TRUCKS. FINAL REPORT, JUL 1973--DEC 1974. Metcalfe, J.E. (Standard Oil Co., Cleveland, Ohio (USA)). Dec 1974. Contract DAAK02-73-C-0493. 69p. NTIS $4.25.

See also report dated Mar 1974, AD--780940..

The Carb-Tek battery employs a porous carbon cathode, a lithium-aluminum alloy anode, a eutectic mixture of potassium chloride and lithium chloride as the electrolyte, and a tellurium tetrachloride additive. The porous carbon cathode is an aggregation of active carbon particles which have been pressed together with a suitable binder. The Carb-Tek battery employs a solid plate anode which is an alloy of aluminum and lithium. The use of this anode avoids corrosion and other problems associated with operating with liquid lithium anodes. This report describes the production of battery cells in the Sohio battery pilot line. A description of process improvements studies on various cell components is given. Pictures showing facilities, cell components and completed cells is presented. (GRA)

574 (AD/A--006548) PRODUCTION AND ENGINEERING METHODS FOR CARB-TEK (TRADE NAME) BATTERIES IN FORK LIFT TRUCKS. FINAL REPORT, JULY 1973--DECEMBER 1974. Metcalfe, J.E. (Standard Oil Co., Cleveland, Ohio (USA); Army Mobility Equipment Research and Development Center, Fort Belvoir, Va. (USA)). Dec 1974. 69p. NTIS $4.25.

The Carb-Tek battery employs a porous carbon cathode, a lithium-aluminum alloy anode, a eutectic mixture of potassium chloride and lithium chloride as the electrolyte, and a tellurium tetrachloride additive. The porous carbon cathode is an aggregation of active carbon particles which have been pressed together with a suitable binder. The Carb-Tek battery employs a solid plate anode which is an alloy of aluminum and lithium. The use of this anode avoids corrosion and other problems associated with operating with liquid lithium anodes. This report describes the production of battery cells in the Sohio battery pilot line. A description of process improvements studies on various cell components is given. Pictures showing facilities, cell components and completed cells is presented.

575 (AD/A--006748) PASSIVE-LITHIUM SECONDARY BATTERIES. FINAL TECHNICAL REPORT, 1 JAN 1974-31 JAN 1975. Rauh, R.D.; Brummer, S.B. (Eic, Inc., Newton, Mass. (USA)). Feb 1975. Contract N00014-74-C-0205. 8p. (C--404-F). NTIS $3.25.

The purpose of this program has been to explore the feasibility of a unique ambient temperature secondary battery system. This report deals exclusively with the rechargeable lithium electrode, which is the major problem area. Specific areas investigated have been the effect of electrolyte composition upon the lithium cycling efficiency, upon the cycle life, and upon the corrosion rate of the electrodeposited material. These variables were studied in three different electrolytic solvents: propylene carbonate (PC) (1), methyl acetate (MA) (2), and methyl pivalate (MP) (3). The electrolytes also contained 1M $LiClO_4$ or 1M $LiAlC_{1_4}$ and, in some experiments, $SO_2$, nitromethane (NM) or $H_2O$. All of the latter additives were found to improve the behavior of the lithium electrode, and were considered as potential ''precursors.'' (GRA)

576 (AD/A--008044) SULFUR-BASED LITHIUM-ORGANIC ELECTROLYTE SECONDARY BATTERIES. QUARTERLY REPORT NO. 4, 4 SEPTEMBER--3 DECEMBER 1974. Holleck, G.L.; Shuker, F.S. (Eic, Inc., Newton, Mass. (USA)). Mar 1975. Contract DAAB07-74-C-0072. 41p. (C--405). NTIS $3.75.

See also AD--003309..

This program is aimed at developing a rechargeable organic-electrolyte lithium battery to operate over the range -40 to +160F, having an energy density approaching 100 Whr/lb, a cycle life in excess of 500, and high charge retention. The approach is to use positive electrodes based on higher sulfides of Nb, Ti and V. Nb and Ti disulfides and trisulfides were prepared thermally. They were characterized by scanning electron microscopy and by x-ray diffraction. Charge--discharge cycles in PC/$LiAlCl_4$ electrolytes are characterized by good reversibility and relatively flat voltage plateaus with mid-discharge potentials of 2.0 V. The discharge mechanism involves a change in the valence of the transition metal. The overall structure of the sulfides influences reversibility strongly during continued cycling. Structure depends on preparation procedures. Molybdenum disulfide is also electrochemically active. (GRA)

577 (AD-A--008849) RESEARCH AND DEVELOPMENT IN THE GLASS FIBER SODIUM--SULFUR BATTERY. SEMIANNUAL TECHNICAL REPORT. Levine, C.A. (Dow Chemical U.S.A., Walnut Creek, Calif.). 31 Dec 1974. Contract DAHC15-73-C-0254. 23p. NTIS $3.25.

See also AD--782059..

The electrochemical characteristics of the hollow fiber sodium-sulfur cell have been shown to be outstanding. The major problem now is to obtain increased lifetimes with the same good performance. The authors want to demonstrate long life (years) with many thousands of charge-discharge cycles in cells that do not change internal resistance with total time in

operation. The heating-cooling characteristics of the cells still must be determined. (GRA)

578 (AD-A--014881) SULFUR-BASED LITHIUM-ORGANIC ELECTROLYTE SECONDARY BATTERIES. QUARTERLY REPORT NO. 5, 4 DEC 19743--MAR 1975. Holleck, G.L.; Driscoll, J.R. (Eic, Inc., Newton, Mass. (USA)). Aug 1975. Contract DAAB07-74-C-0072. 32p. (C--405-5). NTIS $3.75.

This program is aimed at developing a rechargeable organic-electrolyte lithium battery to operate over the range -40 to +160 F, have an energy density approaching 100 Wh/lb, a cycle life in excess of 500, and high charge retention. The approach is to use positive electrodes based on higher sulfides of Nb, Ti and V. Ti disulfides and trisulfides were prepared thermally. They were characterized by scanning electron microscopy and by x-ray diffraction. Both sulfides are electrochemically active and show similar overall behavior. Charge--discharge cycles in PC ($LiAlCl_4$, $LiClO_4$, $LiBF_4$) electrolytes are characterized by relatively flat voltage plateaus with mid-discharge potentials of 2.0 V. (GRA)

579 (AD-A--015018) NEW MECHANICALLY RECHARGEABLE ZINC-AIR BATTERIES. FINAL REPORT, 15 APR 1973--30 APR 1975. Giltner, J. (Eagle-Picher Co., Joplin, Mo. (USA)). Aug 1975. Contract DAAB07-73-C-0149. 48p. NTIS $3.75.

The design, development and testing of new mechanically rechargeable zinc-air batteries are described. Following research and development of a low cost silver-mercury cathode catalyst, prototype battery tests were conducted. Cycle life tests at 3.5 amperes indicated satisfactory performance through at least 26 cycles when this test was terminated for the final hardware build. The cathode bi-cell design utilized the 75 AH plastic frames which were cut down in height and width. Woven-zinc anodes were tested during the program, but were found to operate at reduced voltage and efficiency. The final anode design was a dry pressed composition of zinc, KOH, and HgO and indicated a very good efficiency at 3.5 amperes. Final batteries were delivered in fabricated plexiglass cases with 22 series - connected cells. Discharge tests were conducted on nine (9) of the ten (10) delivered batteries. (GRA)

580 (AD-A--015520) R AND D FOR HYBRID BATTERY AND CELL STUDIES. FINAL REPORT, 1 APR 1973--15 APR 1975. Christianson, C.C.; Menard, C.J.; Rubischko, R.J.; Thimmesch, D.M. (Gould, Inc., St. Paul, Minn. (USA). Energy Research Lab.). Aug 1975. Contract DAAB07-73-C-0127. 104p. NTIS $5.25.

Three areas of work are described. These are the Primary Battery Investigation, the Secondary Battery Investigation, and the System Design and Charge Control Development. The primary battery investigation covered zinc-air, Li-organic, Zn-HgO, and Mg-$MnO_2$ cells with cell performance being characterized over a temperature range of -40 to 140F and a load current range of C/250 to C/5. Highest energy density was obtained from the zinc-air and Li-organic cells with the zinc-air cells showing superior energy density at temperatures above 0F and the Li-organic cells giving better performance at temperatures below 0F. Energy density, voltage and capacity data are presented for the primary systems over the temperature and load range previously indicated. A high-rate low temperature sealed nickel-cadmium cell, of a sub-C size, was developed and is described. Secondary performance data indicates that hybrid operation, at discharge and charge rates of 6C and 1C, respectively and cell temperatures as low as 10F, will be possible without parasitic heaters. Reliable operation below 10F will require the use of parasitic heaters. Various methods of charge state sensing and charge control were investigated and are described. (GRA)

581 (AD-A--016643) LITHIUM BATTERIES: AN OVERVIEW. TECHNICAL NOTE. Nagy, G.D. (Defence Research Establishment, Ottawa, Ontario (Canada)). Oct 1974. 26p. (DREO-TN--74-29). NTIS $3.75.

In the search of high-energy density batteries, lithium systems have always been prime candidates because of their low equivalent weight and high potential. Problems have been concerned with handling and efficient utilization of the active components. The recent advent of promising commercial batteries has demonstrated the viability of lithium systems. This paper reviews some of the promising systems and their problems. (GRA)

582 (AD-A--016770) TELLURIUM CHLORIDE THERMOREGENERATIVE GALVANIC CELL. FINAL REPORT, 1 MAR 1968--28 FEB 1969. Anthes, D.E. (IIT Research Inst., Chicago, Ill. (USA)). 2 Apr 1969. Contract N00019-68-C-0361. 145p. (IITRI-C--6142-5). NTIS $5.75.

The major problems encountered in developing a successful tellurium chloride thermally regenerative galvanic cell (TRGC) have been the regeneration of spent anolyte fluide to cell electroactive species and the subsequent separation of regenerated materials. It has been determined that complexing tellurium tetrachloride ($TeCl_4$) with appropriate materials, while not seriously affecting cell potentials, allows liquid-gas separation of regenerated electroactive materials. The decomposition characteristics of $TeCl_4$ and its complex compounds with gallium trichloride ($GaCl_3$) and aluminum trichloride ($AlCl_3$) have ben studied as approaches to efficient thermoregeneration processes. A new apparatus for the determination of the apparent limiting kinetic decomposition rates of complex materials is described. Preliminary investigations of the properties of $TeCl_4$ complexes with iron trichloride ($FeCl_3$), bismuth trichloride ($BiCl_3$) and other agents were initiated in order to determine their applications as candidate materials for thermoregeneration schemes. (GRA)

583 (AD-A--017642) SULFUR-BASED LITHIUM--ORGANIC ELECTROLYTE SECONDARY BATTERIES. QUARTERLY REPORT NO. 6, 4 MAR 1975--3 JUN 1975. Holleck, G.L.; Driscoll, J.R. (Eic, Inc., Newton, Mass. (USA)). Nov 1975. Contract DAAB07-74-C-0072. 42p. (C--405-6). NTIS $4.00.

See also report dated Aug 1975, AD-A--014881.

This program is aimed at developing a rechargeable organic-electrolyte lithium battery to operate over the range -40 to +160 F, have an energy density approaching 100 Wh/lb, a cycle life in excess of 500, and high charge retention. The approach is to use positive electrodes based on higher sulfides of Nb, Ti, and V. Ti disulfides and trisulfides were prepared thermally. Both sulfides are electrochemically active and show similar overall behavior. Charge--discharge cycles in PC and methyl acetate ($LiAlCl_4$, $LiClOH_4$)

electrolytes are characterized by relatively flat voltage plateaus with mid-discharge potentials of 2.0 V. The discharge cutoff potential, the sulfide preparation, and the solvent appear to affect the cycling behavior. Charge and discharge reactions of $TiS_2$ electrodes are relatively rapid. Diffusion of $Li^+$ ions in the sulfide and the electrolyte appear to be rate limiting. (GRA)

584 (AD-A--018106) PRODUCTION AND ENGINEERING METHODS FOR CARB-TEK (TRADE NAME) BATTERIES IN FORK LIFT TRUCKS. INTERIM REPORT SEP 1974--FEB 1975. Schaefer, J.C. (ESB, Inc., Yardley, Pa. (USA). ESB Technology Center). Mar 1975. Contract DAAK02-75-C-0035. 57p. (TC--6452). NTIS $4.50.

The purpose of this program is to develop the manufacturing technology of the Carb Tek molten salt Li/Cl battery to the prototype level. This purpose is being accomplished by actually constructing cells on a pilot line, optimizing process steps, establishing quality control procedures, and engineering appropriate changes. The majority of the cell work is performed in a controlled argon atmosphere. Results show that the carbon selected for the cell cathode can develop the required 5 $Wh/in.^3$ even when damaged by stress cracks. Anode contamination and fabrication problems have been reduced by a new alloying technique. Cell yields are dependent on weld quality. (GRA)

585 (AD-A--020164) INVESTIGATION OF HIGH TEMPERATURE BATTERY SYSTEMS. FINAL REPORT, 1 JUL 1974--31 AUG 1975. Sayano, R.R.; McClanahan, M.L.; Male, J.A.; Fried, N. (TRW Systems Group, Redondo Beach, Calif. (USA)). Dec 1975. Contract DAAB07-74-C-0587. 60p. (TRW--26619-6013-RU-00). NTIS $4.50.

Hermetically sealed sodium--sulfur cells intended to operate at 300 C in atmospheric environment and to deliver 10 A for 2 hr above 1.0 V for 100 cycles with a specific power and specific energy of 110 W/kg and 110 Wh/kg were designed and fabricated. The cells were to withstand five thermal cycles from operating temperature to room temperature without loss of electrical performance. These cells utilized a disk-shaped magnesium oxide-enriched β-alumina electrolyte with low-cost materials for cell containers. The seals used in the cell were all based on state-of-the-art technology and comprised a glass sealant between the β-alumina electrolyte and the α-alumina rings, copper braze between the α-alumina rings and the Kovar cell containers, and laser welds between the Kovar cell containers and the stainless steel cell cover. Chromium plasma coating was used to protect the copper braze and Kovar against corrosion by sulfur and/or sodium polysulfide. No catastrophic cell failure due to cell design or materials of construction has been observed during testing of a cell for over 800 hr. (GRA)

586 (AD-A--020365) STANDARD LINE RECHARGEABLE BATTERY, SILVER--ZINC BB519/U. FINAL REPORT JUL 1973--JAN 1975. Skelton, J. (Yardney Electric Corp., Pawcatuck, Conn. (USA)). Jan 1975. Contract DAAB07-73-C-0302. 37p. NTIS $4.00.

The electrochemical system used in this battery consists of silver and zinc electrodes. The electrolyte is a concentrated aqueous solution of potassium hydroxide. The separator system is proprietary to Yardney and is designed to assure excellent capacity maintenance after extended cycle life. The silver electrode is made from fine silver powder rolled onto a silver expanded metal grid. The zinc electrode is made from zinc oxide powder rolled onto a perforated copper grid. The separator system is wrapped around the positive electrode. The manufacturing processes used on these plates yield electrodes that offer strength and plate integrity sufficient to meet the environmental and mission requirements. The BB519 and BB462 Batteries have successfully demonstrated that a 16-pound silver--zinc battery yielding 25 Ah can be integrated into the standard line configuration. The addition of a high rate battery to the standard line offers extended capability to man-pack applications. (GRA)

587 (AD-A--022350) DEVELOPMENT OF NICKEL--ALKALINE BATTERIES FOR AEROSPACE LIGHTWEIGHT SECONDARY POWER. FINAL REPORT, 1 DEC 1972--30 JUN 1975. Puglisi, V.J.; Ralph, E.L. (Spectrolab, Inc., Sylmar, Calif. (USA)). Jun 1975. Contract F33615-73-C-2012. 170p. NTIS $6.75.

This program successfully incorporated new, improved electrode fabrication procedures into a small scale pilot production facility and produced advanced lightweight aerospace nickel--cadmium cells. The objectives of achieving a minimum energy density of 20 Wh/lb with the 50-Ah sealed nickel--cadmium cells was accomplished, and two pilot production runs demonstrated that this objective was reached with reproducible results and good yields. The first portion of the program was the investigative phase, in which theoretical and analytical studies were performed. The plaque formation process was optimized in respect to sinter porosity and loading level by using an electrochemical impregnation technique. In order to develop the optimum cell design, the knowledge obtained from the investigative phase was successfully applied to a mathematical cell design model that was translated into computer language. A computer design of several cells that met the program objectives was then developed. (GRA)

588 (AD-A--023496) SULFUR-BASED LITHIUM--ORGANIC ELECTROLYTE SECONDARY BATTERIES. FINAL REPORT, 3 DEC 1973--29 AUG 1975. Holleck, G.L.; Driscoll, J.R.; Shuker, F.S. (Eic, Inc., Newton, Mass. (USA)). Mar 1976. Contract DAAB07-74-C-0072. 171p. (C--405). NTIS $6.75.

The overall aim of this program was the development of a rechargeable lithium battery utilizing an organic solvent. Specifications included operation over the range -40 to +160 F (-40 to +70 C), energy density approaching 100 Wh/lb, a cycle-life in excess of 500, and high charge retention. A system meeting all these specifications would represent a considerable advance in the state of the art. An analysis of possible alternatives suggested the likelihood of developing such batteries with positive electrodes based on sulfur. Two general classes are promising: soluble sulfur positives, and positives based on higher sulfides of transition metals, particularly on sulfur-rich compounds of titanium, niobium, and vanadium. Initially, both systems were investigated. Then, since only one of the two approaches towards sulfur based cathodes could be continued within the scope of this investigation, it was decided to concentrate on the transition metal sulfides, as they have more immediate prospects for practical use. (GRA)

589 (AD-A--026171) EQUIVALENT CIRCUIT FOR SERIES CONNECTED GC23C NICKEL-CADMIUM CELLS. INTERIM TECHNICAL REPORT, APR 1974--MAR 1976. Fritts, D.H. (Air Force Aero-Propulsion Lab.,

Wright-Patterson AFB, Ohio (USA)). May 1976. 30p. (AFAPL-TR--76-18). NTIS $4.00.

An electrical equivalent circuit for nickel-cadmium batteries, using GC23C cells, is derived that has fixed, lumped parameter circuit elements and is scalable for series connected cells. Some of the individual circuit elements are investigated to determine if they can be related to physiochemical phenomena in the batteries. The results of this work show that equivalent circuits that are useful to the electrical engineer are feasible and that its elements are interpretable.

590 (AD-A--026359) RESEARCH DEVELOPMENT IN THE GLASS FIBER SODIUM--SULFUR BATTERY. SEMI-ANNUAL REPORT 1 JUL--31 DEC 1975. Levine, C.A. (Dow Chemical U.S.A., Walnut Creek, Calif.). 31 Dec 1975. Contract DAHC15-73-C-0254,. 30p. NTIS (US Sales Only).

The sodium--sulfur battery based on hollow glass fibers as the electrolyte has been shown to have outstanding characteristics as a rechargeable cell. It should be capable of 100 watt hours per pound at over 80 watts per pound, and not be damaged by charge/discharge cycling. The major problems are to obtain increased lifetimes, to demonstrate non-variance in its electrochemical characteristics over thousands of cycles, and to assemble the cells into metal envelopes and into high voltage batteries. The batteries, like the cells, must be capable of long-lived non-variant operation. The problems are being defined and attacked by building and operating various size hollow-fiber cells. These cells range from single fiber cells to cells containing many thousands of fibers. When these cells fail, the failure mode is analyzed. Small assemblies are designed and built that can test specific parts of the cells which may be involved in the failure. For example, single fibers or small bundles of fibers can be assembled and used as a Na anode discharging and charging into a sodium or a sulfide pool to test the effect of passage of sodium ions on the glass lifetime. As improvements are made, the cells are scaled up to confirm the improvements and to see if scaling up introduces new factors affecting the cell lifetime. (GRA)

591 (AD-A--035983) PRODUCTION AND ENGINEERING METHODS FOR CARB-TEK (TRADE NAME) BATTERIES IN FORK LIFT TRUCKS. INTERIM REPORT MAR 1975--MAR 1976. Schaefer, J.C. (ESB, Inc., Yardley, Pa. (USA). ESB Technology Center). Mar 1976. Contract DAAK02-75-C-0035. 59p. NTIS, PC A04/MF A01.

See also report dated Mar 75, AD-A018 106..

The purpose of this program is to establish the manufacturing techniques for production of improved fork lift truck batteries. This portion involves the manufacturing technology of the Carb-Tek molten salt Li/Cl system, constructing cells on a pilot line, optimizing process steps, establishing quality control procedures, and engineering appropriate changes. Cell assembly is performed in a controlled argon atmosphere. Average capacity of pilot line design 6 cells was 8 Ah with a maximum value of 10.6. Maximum value of cathodes as formed was 12.75 Ah. A new, economical anode alloy preparation is reported. System maintenance problems were greatly reduced by improved leak detection.

592 (AD-A--036280) RECHARGEABLE METAL OXIDE--HYDROGEN CELLS. RESEARCH AND DEVELOPMENT TECHNICAL REPORT. Wynn, J.E. (Army Electronics Command, Fort Monmouth, N.J. (USA)). Jan 1977. 22p. (ECOM--4465). NTIS PC A02/MF A01.

Electrically rechargeable nickel oxide--hydrogen cells (rated 1.0 amperehour) were fabricated using platinum-catalyzed hydrogen anodes, nicekl--oxide cathodes, and a two component separator system, Pellon/PKT, saturated with 30% KOH electrolyte. Also, silver oxide--hydrogen cells (rated 1.5 amperehours) were fabricated using similar platinum catalyzed hydrogen anodes, silver oxide cathodes, and two different separator systems, Pellon/PKT and Dynel/cellophane/Pellon, saturated with 30% KOH electrolyte. The charge and discharge performance capabilities of the two types of electrically rechargeable cells were measured at room temperature at current densities up to 100 milliamperes per square centimeter. The Faradaic and thermodynamic efficiencies and cycle life of the cells were determined at various charge and discharge rates.

593 (AD-A--037215) RESEARCH AND DEVELOPMENT IN THE GLASS FIBER SODIUM--SULFUR BATTERY. SEMI-ANNUAL TECHNICAL REPORT. Levine, C. (Dow Chemical U.S.A., Walnut Creek, Calif.). 1 Jul 1976. Contract DAHC15-73-C-0254. 21p. NTIS, PC A02/MF A01.

The following topics are considered: technical problems; general methodology; technical results; implications for further research; causes of cell degradation; testing of cells and evaluation; and back-up for cell fabrication and assembley.

594 (AD-A--037216) RESEARCH AND DEVELOPMENT OF THE GLASS FIBER SODIUM. Levine, C. (Dow Chemical U.S.A., Walnut Creek, Calif.). 6 Oct 1976. Contract DAHC15-73-C-0254. 51p. NTIS, PC A04/MF A01.

Development work in the sodium--sulfur rechargeable cell which uses the walls of fine hollow glass fibers as the electrolyte has led to much longer lasting cells capable of thousands of deep and rapid cycles. The longest lived multifiber cell to date, cycling at over 90% depth, has undergone over 2300 cycles in 92 days and is still in operation. This cell should be capable of over 220 watt hours per kg. Cell life is shortened by certain impurities in the Na, by nonfused tubesheets, and by fibers weakened during processing. Removal of these harmful effects, problems in scaling up cell size, in developing a metal case for the cell, in thermal cycling, and in fabrication of the cell parts are described.

595 (AD-A--037676) TRANSITION METAL COMPOUNDS AS CATHODIC MATERIALS IN RECHARGEABLE LITHIUM CELLS. TECHNICAL REPORT. Hunger, H.F.; Ellison, J.E. (Army Electronics Command, Fort Monmouth, N.J. (USA)). Feb 1977. 19p. (ECOM--4474). NTIS, PC A02/MF A01.

A comparison was made between rechargeable lithium batteries, based on lithium intercalation or lithium interstitial compounds of transition metal chalcogenides or oxides, and nickel--cadmium batteries. Several chalcogenides and oxides show promise as cathodic materials. Preliminary experimental work was done with lithium--molybdenum trioxide cells. The polarization characteristics of the molybdenum trioxide cathode were studied and some insight in the reaction mechanism was gained. In charge--discharge experiments, the capacity loss after deep cycling was explored; the energy efficiency and the energy content of the system were determined.

596 (AD-A--037721) SURVEY OF CONTINUOUS SOURCES OF ELECTRICAL POWER FOR UNDER-ICE PROPULSION OF SMALL SUBMERSIBLES. PART II. NEW HIGH ENERGY DENSITY SYSTEMS. King, T.E.; Moroz, W.J. (Defence Research Establishment, Ottawa, Ontario (Canada)). Mar 1977. 20p. (DREO-R--757). NTIS, PC A02/MF A01.
Abstract in French. See also Part 1, AD-A--035996.
New, high energy density electrochemical systems are discussed from the point of view of meeting the forecast electrical requirements for the SDL-1 submersible in the 1980-90 time frame. Three main categories of systems are considered; namely, aqueous, metal/oxygen, and high temperature. Since most new high energy density systems are still in the conceptual stage, with many engineering problems yet to be resolved, the technical and economic merits are reviewed mainly in general terms. The systems with the best near- and long-term development potential are critically examined and assessed.

597 (AD-B--002753) QUARTERLY PROGRESS NOTES, 1 JULY 1974--30 SEPTEMBER 1974. (Defence Research Establishment, Ottawa, Ontario (Canada)). Dec 1974. 66p. NTIS.
The electrical power sources division conducts research and development studies on electrical power sources for transport (land, air and water), communications (beacons, radars, etc.) and special equipment (radiation detectors, fuzes, etc.) for the Canadian forces. Also the division has been involved with the batteries for the canadian research satellites. The EPS division devotes considerable effort to power sources for low temperature applications.

598 (AD-B--004545) QUARTERLY PROGRESS NOTES, 1 JANUARY 1975--31 MARCH 1975. (Defence Research Establishment, Ottawa, Ontario (Canada)). May 1975. 70p. NTIS.
Research progress is discussed on low-temperature primary batteries, sea-water batteries, other primaries, low-temperature lead/acid batteries, Ni/Cd batteries, fuel cell systems, other secondaries, Ni/Cd aircraft batteries, fuze batteries, and optimization studies of satellite batteries for DOC. Contracts and consultations are summarized.

599 (AD-B--009796) QUARTERLY PROGRESS NOTES, 1 OCTOBER 1975--31 DECEMBER 1975. (Defence Research Establishment, Ottawa, Ontario (Canada)). Feb 1976. 52p. NTIS.
Research progress in low-temperature primary batteries, sea-water batteries, other primaries, low-temperature lead/acid batteries, Ni/Cd batteries, fuel cell systems, other secondaries and contracts and consultations are described.

600 (AD-B--013277) ELECTRICAL POWER SOURCES DIVISION QUARTERLY PROGRESS NOTES, 1 JANUARY 1976--31 MARCH 1976. (Defence Research Establishment, Ottawa, Ontario (Canada)). May 1976. 48p. (PD--19199). Dep. NTIS (US Sales Only) $4.00.
The Primary Power Sources Section is responsible for carrying out research and development tasks, maintaining expertise, and providing technical consultants in the general field of primary power supplies. Subjects of immediate interest include batteries activated by sea-water or other saline electrolytes for use in torpedo-propulsion systems, sono(ar)buoys and distress beacons; unconventional primaries with improved low-temperature performance characteristics for radio transceivers and various types of beacons; and solid-electrolyte systems for fuze battery applications. The Rechargeable Systems Section has responsibilities similar to those of the Primary Power Sources Section but with respect to secondary batteries and fuel cells. Present investigations include the low-temperature performance of the lead/acid battery, Ni/Cd aircraft battery problems, and the evaluation of the low-temperature performance of fuel cells. This section is also responsible for the studies on nickel/cadmium satellite cells. This report breifly summarizes objectives, goals, and progress for this quarter for a number of tasks.

601 (ADB--007328) ELECTRICAL POWER SOURCES DIVISION, QUARTERLY PROGRESS NOTES, 1 APRIL 1975--30 JUNE 1975. (Defence Research Establishment, Ottawa, Ontario (Canada)). Sep 1975. 55p. (PD--18800). Dep. NTIS (US Sales Only) $5.50.
FUEL CELLS;ALCOHOL FUEL CELLS;HYDROGEN FUEL CELLS;ELECTROCHEMISTRY;RESEARCH PROGRAMS; ELECTRIC BATTERIES;NICKEL-CADMIUM BATTERIES; LEAD-ACID BATTERIES;AIRCRAFT;SATELLITES

602 (ADB--008547) ELECTRICAL POWER SOURCES DIVISION, QUARTERLY PROGRESS NOTES, 1 JULY 1975--30 SEPTEMBER 1975. (Defence Research Establishment, Ottawa, Ontario (Canada)). Nov 1975. 61p. (PD--18972). Dep. NTIS (US Sales Only) $4.50.
The Primary Power Sources Section is responsible for carrying out research and development tasks, maintaining expertise and providing technical consultants in the general field of primary power supplies. Subjects of immediate interest include batteries activated by sea water or other saline electrolytes for use in torpedo-propulsion systems, sono(ar)buoys, and distress beacons; unconventional primaries with improved low-temperature performance characteristics for radio transceivers and various types of beacons; and solid-electrolyte systems for fuze battery applications. The Rechargeable Systems Section has responsibilities similar to those of the Primary Power Sources Section, but with respect to secondary batteries and fuel cells. Present investigations include the low-temperature performance of the lead--acid battery, Ni--Cd aircraft battery problems, and the evaluation of the low-temperature performance of fuel cells. This section is also responsible for the studies on nickel--cadmium satellite cells. (RWR)

603 (AED-Conf--76-444-016) TRACTION BATTERIES FOR EXISTING AND FUTURE ELECTRIC ROAD VEHICLES. Salamon, K.; Kraemer, G. (Varta Batterie A.G., Kelkheim (Germany, F.R.). Forschungs- und Entwicklungszentrum). 1976. 33p. (In German). (CONF-760866--4). Dep. NTIS (US Sales Only), PC A03/MF A01.
From 4. international electric vehicle symposium; Dusseldorf, F.R. Germany (31 Aug 1976).
The report handles the development of traction batteries for road vehicles. It is divided into two parts. In the first part a new lead--acid traction battery is discussed; and in the second, a new nickel oxide--iron battery. The theoretical energy densities for both systems are given. The specific energy values, experimentally attained, lie at about 40 Wh/kg in the case of the lead--acid accumulator and at about 50 Wh/kg in the case of the nickel oxide--iron accumulator. The measures for attaining these values are given.

For the lead--acid accumulator the values, attained through experience of electric operation using batteries of this type, are reported. The possibilities of further development are explored. Regarding the use of batteries for powering vehicles, 800 cycles with a lead-acid accumulator and 1,000 cycles with a nickel oxide--iron accumulator can at the moment be calculated. Future research problems are given.

604 (AI--74-55) RECHARGEABLE LITHIUM--SULFUR BATTERY. EXECUTIVE SUMMARY, PROGRESS THROUGH 1973. Heredy, L.A.; McCoy, L.R.; Lai, S.; Saunders, R.C. (Atomics International Div., Canoga Park, Calif. (USA)). 27 Jun 1974. 11p.

Metal sulfide cathodes, LiCl--KCl electrolyte. METAL-NONMETAL BATTERIES;LITHIUM; COPPER SULFIDES;POTASSIUM CHLORIDES;LITHIUM CHLORIDES;IRON SULFIDES;ELECTRIC POTENTIAL; TESTING;PERFORMANCE;DESIGN

605 (ANL--75-1) HIGH-PERFORMANCE BATTERIES FOR OFF-PEAK ENERGY STORAGE AND ELECTRIC-VEHICLE PROPULSION. PROGRESS REPORT FOR THE PERIOD JULY--DECEMBER 1974. (Argonne National Lab., Ill. (USA)). Jul 1975. Contract W-31-109-Eng-38. 145p. Dep. NTIS $7.60.

ANL;LITHIUM-SULFUR BATTERIES;OFF-PEAK ENERGY STORAGE;ELECTRIC-POWERED VEHICLES;LITHIUM ALLOYS;ALUMINIUM ALLOYS;IRON SULFIDES;LITHIUM CHLORIDES;POTASSIUM CHLORIDES;HIGH TEMPERATURE; ELECTRODES;MATERIALS;CONNECTORS;CORROSION; ELECTROCHEMISTRY;ECONOMICS;DESIGN; SPECIFICATIONS;PERFORMANCE;TESTING;PHASE STUDIES;BATTERY SEPARATORS

606 (ANL--75-20) DEVELOPMENT OF LITHIUM/METAL SULFIDE BATTERIES AT ARGONNE NATIONAL LABORATORY: SUMMARY REPORT FOR 1974. (Argonne National Lab., Ill. (USA)). Mar 1975. Contract W-31-109-Eng-38. 24p. Dep. NTIS $4.00.

Li--Al/FeS and Li--Al/$FeS_2$. LITHIUM-SULFUR BATTERIES;OFF-PEAK ENERGY STORAGE;ELECTRIC-POWERED VEHICLES;IRON SULFIDES;LITHIUM ALLOYS; ALUMINIUM BASE ALLOYS;TESTING;COST;ELECTRODES; FABRICATION;ELECTROCHEMISTRY

607 (ANL--75-36) HIGH-PERFORMANCE BATTERIES FOR OFF-PEAK ENERGY STORAGE AND ELECTRIC-VEHICLE PROPULSION. PROGRESS REPORT, JANUARY--JUNE 1975. (Argonne National Lab., Ill. (USA)). Mar 1976. Contract W-31-109-Eng-38. 126p. Dep. NTIS $7.00.

This report describes the research and management efforts, for the period January--June 1975, of Argonne National Laboratory's program on high-performance lithium/metal sulfide batteries. The batteries are being developed for two applications, off-peak energy storage in electric utility networks and electric-vehicle propulsion. The battery design for the two applications differ, particularly in cell configuration and electrode design, because of the differing performance requirements. The present cells are vertically oriented, prismatic cells with two negative electrodes of a solid lithium--aluminium alloy, a central positive electrode of iron sulfide ($FeS_2$ or FeS), and an electrolyte of LiCl--KCl eutectic (mp, 352°C). The operating temperature of the cells is about 400--450°C. Recent effort in the development of engineering-scale cells was focused on designing and fabricating vertically oriented, prismatic cells and on improving the lifetime capabilities of cells. Work on electrode development was directed toward the evaluation of the factors that influence the performance of the negative electrode and the development of new designs of vertical, prismatic iron sulfide electrodes. Materials studies included work on improving feedthroughs and separators, corrosion tests of candidate materials of construction, and postoperative examinations of cells. Cell chemistry studies included continuing investigations of cell reactions and the identification of advanced cell systems. Battery development work included the design of a battery for an electric automobile and the development of battery components. The transfer of Li--Al/FeS/sub x/ battery technology to industry is being implemented through contracts with industrial firms for the manufacture of components, electrodes, and cells.

608 (ANL--76-8, pp A.34-A.48) LEAD--ACID BATTERY. Simon, A.C. (Naval Research Lab., Washington, DC); Caulder, S.M. 1976.

From Battery workshop; Argonne, Illinois, USA (21 Mar 1976).

Proceedings of the symposium and workshop on advanced battery research and design, March 22--24, 1976.

The lead--acid battery has shown a slow but steady development over the years of its history. Most of its improvements have been obtained through engineering development, and there has been relatively little basic research. At a period when there is the possibility of two major markets for batteries, those of energy storage and electric vehicles, one should not too soon dismiss this battery from consideration. Although at present marginal for both of these applications, there is the distinct possibility that with the proper research the life and energy density of this battery can be increased to the point where it may look a lot more attractive than at present. Some of the problem areas and possible solutions are discussed.

609 (ANL--76-8, pp A.49-A.65) CURRENT STATUS AND PROSPECTS OF THE ZN--AIR AND NA--S BATTERIES IN FRANCE. Appleby, A.J. (Laboratoires de Marcoussis, France); Gabano, J.P. 1976.

From Battery workshop; Argonne, Illinois, USA (21 Mar 1976).

Proceedings of the symposium and workshop on advanced battery research and design, March 22--24, 1976.

The Compagnie Generale d'Electricite is currently conducting development work on both a circulating-slurry zinc--air battery with either built-in or external recharging facility and on the sodium--sulfur--β-alumina battery. The first system promises to be effective vehicle power unit with sufficient energy density to give useful vehicle performance (110W Wh/kg : about 150 km range for a practical city-car with normal payload). Power units were extensively tested over the past three years in the form of laboratory modules, and sufficient data to predict practical lifetime, performance, and manufacturing cost were obtained. An upper-limit system cost of $40 (1974)/kW is expected. Practical lifetime will be at least 2000 running hours. The sodium--sulfur battery, whose development time will be longer, may be applied to either vehicles or to industrial purposes for which the efficiency of the zinc--air system (40 percent overall) is not sufficiently high (e.g., offpeak storage). Over 6000 cycle (24000 hours total) have been obtained with laboratory cells using pure β-alumina electrolytes. Problems that must be solved to develop practical battery systems are summarized. 7 figures, 1 table.

610 (ANL--76-8, pp A.81-A.97) HIGH-TEMPERATURE BATTERIES. Cairns, E.J.; Dunning, J.S. (General Motors Corp., Warren, MI). 1976.
From Battery workshop; Argonne, Illinois, USA (21 Mar 1976).
Proceedings of the symposium and workshop on advanced battery research and design, March 22--24, 1976.
The state of the art for high-temperature batteries is presented and discussed. Emphasis is given to the lithium alloy/metal sulfide and sodium/sulfur cells. Other systems considered include lithium/chlorine and sodium/metal halide. Cell chemistry and performance and life-limiting factors are reviewed for all systems, and the status of investigations in critical problem areas is given. Recent advances in the demonstration of high specific energy and expectations for future improvement are presented. 11 figures, 4 tables.

611 (ANL--76-8, pp A.99-A.106) COMPARISON OF U.S. AND EUROPEAN HIGH-TEMPERATURE BATTERY PROGRAMS. Nelson, P.A. (Argonne National Lab., IL). 1976.
From Battery workshop; Argonne, Illinois, USA (21 Mar 1976).
Proceedings of the symposium and workshop on advanced battery research and design, March 22--24, 1976.
Most of the present effort on high-temperature batteries, both in the U.S. and in Europe, is directed toward the development of sodium/sulfur and lithium/metal sulfide systems. This paper describes the major programs on both continents, and compares the economic incentives for battery development, the intended applications, the cell and battery designs, and the unsolved technical problems. Also discussed is the increased effort that is needed in the areas of battery design and development of low-cost components to produce batteries that are economically attractive for the intended applications. 1 table.

612 (ANL--76-8, pp B.210-B.218) DEVELOPMENT OF UNCHARGED LI--AL/FES CELLS. Shimotake, H.; Bartholme, L.G. (Argonne National Lab., IL). 1976.
From Battery workshop; Argonne, Illinois, USA (21 Mar 1976).
Proceedings of the symposium and workshop on advanced battery research and design, March 22--24, 1976.
Cells having negative electrodes of lithium--aluminium alloy and positive electrodes of iron sulfide (FeS) are being developed at Argonne National Laboratory for energy storage batteries to be used for utility load-leveling. This paper describes a Li--Al/FeS cell that is assembled in the uncharged state. The principal difference from previous cells is in the method of preparing the positive electrode; in this method $Li_2S$, iron powder, and electrolyte salt are blended and hot-pressed into a plaque (copper powder was also included in some of the electrodes). The use of this type of electrode overcame many previous difficulties, primarily excessive swelling, low utilization, and gassing. The new cells showed outstanding performance, with utilizations and energy efficiencies exceeding 85 percent at the 10-h rate. 6 figures, 1 table.

613 (ANL--76-8, pp B.219-B.230) SODIUM/SULFUR BATTERY: A PROGRESS REPORT. Weiner, S.A. (Ford Motor Co., Dearborn, MI). 1976.
From Battery workshop; Argonne, Illinois, USA (21 Mar 1976).
Proceedings of the symposium and workshop on advanced battery research and design, March 22--24, 1976.
Work on sodium--sulfur cells is presented, with emphasis on various aspects of cell design and testing. The baseline studies for the cell testing program were run on cells that were constructed of carbon and glass and contained no metal other than sodium. Separate cells, designed to maximize energy and power density were studied. A preliminary discussion of materials costs is included. 8 figures, 5 tables.

614 (ANL--76-8, pp B.239-B.251) CURRENT STATUS OF THE ATOMICS INTERNATIONSL LITHIUM--IRON SULFIDE BATTERY DEVELOPMENT. Heredy, L.; McCoy, L.; Sudar, S. (Rockwell International, Canoga Park, CA). 1976.
From Battery workshop; Argonne, Illinois, USA (21 Mar 1976).
Proceedings of the symposium and workshop on advanced battery research and design, March 22--24, 1976.
A program for the development of lithium--iron sulfide batteries for electric utility load-leveling is being conducted at Atomics International. These batteries use a molten KCl--LiCl electrolyte and are operated at a temperature of 400°C or higher. A lithium--silicon alloy, $Li_5Si$, is used as the active material in the negative electrodes. Positive electrodes contain the iron sulfides FeS, $FeS_2$ or their mixture. Electrode development tasks are concerned with minimizing the cost of supporting structures and optimizing electrode performance. Porous ceramic separators based upon rigid structural materials are being developed. Rigid separators used in current experimental cells are either prepared by processes under development or are purchased. Cell development is being conducted through scale-up stages involving increasing electrode area and numbers of parallel connected electrodes to reach a 2.5 kWh modular cell. A status review of this effort is presented. 8 figures, 1 table.

615 (ANL--76-8, pp B.252-B.262) HIGH TEMPERATURE RECHARGEABLE CELLS WITH DOPED $CAF_2$ AS A SOLID ELECTROLYTE. Baukal, W. (Battelle-Institut E.V., Frankfurt/Main); Kuhn, W.; Voss, E. 1976.
From Battery workshop; Argonne, Illinois, USA (21 Mar 1976).
Proceedings of the symposium and workshop on advanced battery research and design, March 22--24, 1976.
Doped calcium fluoride is applied as a solid electrolyte for high-temperature secondary cells using calcium and copper fluoride as electrode materials. The cell reaction is given by the equation Ca + $CuF_2$ in equilibrium $CaF_2$ + Cu. The cell voltage is measured to be 3.37 V at 450°C, which is in good agreement with the value of 3.39 V calculated from thermodynamic data. Results obtained on cycling experiments are reported. 7 figures, 3 tables.

616 (ANL--76-8, pp B.264-B.276) MODELING APPROACHES FOR MOLTEN-SALT LITHIUM/SULFIDE BATTERIES. Hickman, T.E.; Kolba, V.M. (Argonne National Lab., IL). 1976.
From Battery workshop; Argonne, Illinois, USA (21 Mar 1976).
Proceedings of the symposium and workshop on advanced battery research and design, March 22--24, 1976.
Methods are being sought for accurately predicting the behavior of lithium--aluminum/iron sulfide molten-salt batteries being

developed at Argonne National Laboratory for electric-vehicle propulsion and off-peak energy storage on utility networks. The successful application of an analytical model would aid in design optimization studies and design iteration and testing. A literature search to determine the state of the art of electrochemical cell modeling showed that little work has been done on the modeling of cells having molten salt electrolytes. This paper presents a summary of information gained in the survey and the results obtained when several existing models were applied to data taken at the terminals of Li--Al/FeS and Li--Al/$FeS_2$ test cells. The present effort is expected to lead to a model which provides complete characterization of the cell and battery components, and thus allows optimization of cell and battery design. 6 figures, 1 table.

617 (ANL--76-9) HIGH-PERFORMANCE BATTERIES FOR OFF-PEAK ENERGY STORAGE AND ELECTRIC-VEHICLE PROPULSION. PROGRESS REPORT, JULY--DECEMBER 1975. (Argonne National Lab., Ill. (USA)). Apr 1976. Contract W-31-109-Eng-38. 97p. Dep. NTIS $5.00.

This report describes the research and management efforts of Argonne National Laboratory's program on high-performance lithium/metal sulfide batteries during the period July--December 1975. The batteries are being developed for two applications: off-peak energy storage in electric utility networks and electric-vehicle propulsion. The battery designs for the two applications differ, particularly in cell configuration and electrode design, because of the differing performance requirements. The present cells are vertically oriented, prismatic cells with two negative electrodes of a solid lithium--aluminum alloy and a central positive electrode of iron sulfide ($FeS_2$ or FeS). The electrolyte is molten LiCl--KCl eutectic, which requires a cell temperature of about 400--450°C. Effort was continued on the development of engineering-scale cells with hot-pressed electrodes assembled in the uncharged state (positive electrode of $Li_2S$--Fe, negative electrode of Al). Studies of electrodes were directed principally toward developing positive electrodes of $FeS_2$ and FeS in carbon-bonded structures and toward improving the performance and lowering the cost of negative Li--Al electrodes. Materials studies included work on improved separators and feedthroughs, corrosion tests of materials in the cell environment, and postoperative examinations of cells. Work in the area of cell chemistry included the continuing studies of cell reactions and investigations of advanced cell systems. Battery design work was directed toward the design of a battery for an electric vehicle, development of battery components, and design and construction of battery testing facilities. Efforts were continued on contractual arrangements with industrial firms to develop and fabricate cells, electrodes, and cell components; the first contractor-produced cells were delivered to ANL. 29 figures, 15 tables.

618 (ANL--76-12) COST ESTIMATE FOR THE COMMERCIAL MANUFACTURE OF LITHIUM/IRON SULFIDE CELLS FOR LOAD-LEVELING. Towle, W.L.; Graae, J.E.A.; Chilenskas, A.A.; Ivins, R.O. (Argonne National Lab., Ill. (USA)). Mar 1976. Contract W-31-109-Eng-38. 73p. Dep. NTIS $4.50.

An estimate was made of the cost of commercial manufacture of batteries for load-leveling in utility networks, based on the Li--Al/FeS system. The battery design chosen is the 0.92-kWh cell proposed for the BEST Facility. The manufacturing plant was sized to produce 5000 of such cells per day. These cells are assembled for sale in battery cases or submodules, 24 cells to a case. The plant investment is estimated to be $12,500,000. A selling price of $29.16 per kWh is projected; this price yields a 25 percent return on invested capital. An allowance for recycle lithium yields a net price of $27.33 per kWh. 30 figures, 5 tables.

619 (ANL--76-35) HIGH-PERFORMANCE BATTERIES FOR OFF-PEAK ENERGY STORAGE AND ELECTRIC-VEHICLE PROPULSION. PROGRESS REPORT, JANUARY--MARCH 1976. Nelson, P.A.; Ivins, R.O.; Yao, N.P.; Battles, J.E.; Chilenskas, A.A.; Gay, E.C.; Steunenberg, R.K.; Walsh, W.J. (Argonne National Lab., Ill. (USA)). May 1976. Contract W-31-109-Eng-38. 56p. Dep. NTIS $4.50.

The research and management efforts of Argonne National Laboratory's program on lithium/metal sulfide batteries during the period January--March 1976 are described. These batteries are being developed for energy storage on utility networks and for electric-vehicle propulsion. The present cells are vertically oriented, prismatic cells with a central positive electrode of FeS or $FeS_2$ and two facing negative electrodes of lithium--aluminum alloy, and an electrolyte of molten LiCl--KCl. The cell operating temperature is 400 to 450°C. The type of cell receiving major attention is one in which the electrodes are assembled in the uncharged state. The active material in the positive electrode is a mixture of $Li_2S$ and iron; the electrode is formed by hot-pressing this material with electrolyte, by loading it into a porous structure of metal, or by incorporating it into a carbon-bonded structure. The negative electrode is a porous aluminum structure, with which the lithium reacts on first charge to form a lithium--aluminum alloy. Several methods of adding excess lithium capacity to the cell are being investigated. Efforts are being made to develop feedthroughs and electrode separators that meet performance and cost goals. Work is also being carried out on an improved design of a battery for energy storage on utility networks and on design and fabrication of other battery components. $Li_2S$ is being characterized in terms of purity and physical characteritics to determine its suitability for use in fabricating uncharged cells. Work is continuing on the development of alternative secondary cell systems with calcium- or magnesium- based negative electrodes and molten-salt electrolytes. 20 figures, 13 tables.

620 (ANL--76-45(Rev.)) DEVELOPMENT OF LITHIUM/METAL SULFIDE BATTERIES AT ARGONNE NATIONAL LABORATORY: SUMMARY REPORT FOR 1975. (Argonne National Lab., Ill. (USA)). May 1976. Contract W-31-109-Eng-38. 35p. Dep. NTIS $4.00.

This report presents highlights for 1975 of Argonne National Laboratory's program on the development of lithium/metal sulfide batteries. The intended applications for these high-performance batteries are energy storage on utilities and electric-vehicle propulsion. The battery cells have negative electrodes of a lithium--aluminum alloy and positive electrodes of $FeS_2$ or FeS, and operate at 400 to 450°C. During the past year, a new cell design was adopted; the cells are prismatic and are operated with the electrodes in a vertical orientation. Conceptual designs for two types of batteries have been completed: an electric-vehicle battery that could be installed under the hood of an automobile and a load-leveling

battery for testing in the Battery Energy Storage Test Facility. Promising methods for fabricating electrodes include loading of powders into porous current collector structures, incorporation of active materials into a carbon-bonded matrix, and hot-pressing of powders. Receiving major attention is a design in which cells are assembled in the uncharged state. Engineering-scale Li-Al/FeS cells of this type have achieved specific energies of 100 W-hr/kg and peak specific powers of 130 W/kg. Cell chemistry studies and materials studies are conducted to provide support to the cell effort. A method was devised for preparing lithium sulfide in a suitable form; studies of cell overcharge reactions led to the establishment of optimum cell cutoff voltages. Corrosion tests and postoperative examinations continue to provide information on construction materials. 12 figures, 3 tables.

621 (ANL--76-81) HIGH-PERFORMANCE BATTERIES FOR OFF-PEAK ENERGY STORAGE AND ELECTRIC-VEHICLE PROPULSION. PROGRESS REPORT, APRIL--JUNE 1976. (Argonne National Lab., Ill. (USA)). Jul 1976. Contract W-31-109-ENG-38. 62p. Dep. NTIS $4.50.

The research and management efforts of the program at Argonne National Laboratory (ANL) on lithium/metal sulfide batteries during the period April--June 1976 are described. These batteries are being developed for energy storage on utility networks and for electric-vehicle propulsion. The present cells, which operate at 400 to 450°C, are vertically oriented, prismatic cells with a central positive electrode of FeS or $FeS_2$, two facing negative electrodes of lithium--aluminum alloy, and an electrolyte of molten LiCl--KCl. Electrodes and cells are being fabricated by several industrial firms. Cells produced are being tested and evaluated--as single cells and as two- and three- cell batteries. New electrode and cell designs are being developed and tested, and promising designs will be incorporated in industrially fabricated cells. The concepts receiving major attention include the fabrication of electrodes in the uncharged state (positive electrodes of $Li_2S$ and Fe and negative electrodes of porous aluminum), the use of carbon-bonded current-collector structures in the positive electrode, the fabrication of electrodes by hot-pressing active materials and electrolyte, and the use of additives. Efforts are also under way to develop improved cell feedthroughs and electrode separators. Design work is in progress on a 30-kWh battery for a small four-passenger vehicle; this effort includes design calculations and setting specifications for the vehicle. Other battery engineering work is directed to the development of monitoring and cycling equipment and battery components. Cell chemistry studies include the wetting of materials by molten LiCl--KCl and potentiometric measurements on metal sulfide phases. Work is continuing on the development of alternative secondary cell systems. 17 figures, 11 tables.

622 (ANL--76-98) HIGH-PERFORMANCE BATTERIES FOR OFF-PEAK ENERGY STORAGE AND ELECTRIC-VEHICLE PROPULSION. PROGRESS REPORT FOR THE PERIOD JULY--SEPTEMBER 1976. (Argonne National Lab., Ill. (USA)). Dec 1976. Contract W-31-109-ENG-38. 63p. Dep. NTIS, PC A04/MF A01.

Research and management efforts on lithium--aluminum/metal sulfide batteries during the period July--September 1976 are described. These cells, which operate at 400--450°C, are vertically oriented, prismatic cells with a central positive electrode of FeS or $FeS_2$, two facing negative electrodes of lithium--aluminum alloy, and an electrolyte of molten LiCl--KCl. A market study and an economic analysis are being performed; cells, cell components, and battery testing equipment are being developed and fabricated by industrial firms under contract; and work is in progress on designs for a 30 kWh electric-vehicle battery and a module for a stationary energy storage battery. Cells fabricated by Eagle-Picher Industries, Inc. were tested as single cells and as two- and three-cell batteries. Design modifications based on evaluations of these tests are in progress. New electrode and cell designs are also being developed and tested at ANL. The concepts receiving major attention include the design of multiple-electrode cells, the fabrication of electrodes in the uncharged state, the use of carbon-bonded current-collector structures in the positive electrode, the fabrication of electrodes by hot-pressing active materials and electrolyte, and the use of additives to the negative electrode. Materials development efforts included optimization of designs of electrical feedthroughs; development of improved electrode separators, e.g., BN and $Y_2O_3$ felts; corrosion tests of construction materials; and postoperative examination of cells. A new type of liquid-lithium electrode, in which lithium from a pool is wicked to the positive electrode, was developed. Investigations of alternative cell systems included tests of small-scale Li/$TiS_2$ and $NaFeS_2$ cells; a larger-scale $CaMg_2$/FeS cell is also being operated. 22 figures, 5 tables.

623 (ANL--77-17) HIGH-PERFORMANCE BATTERIES FOR STATIONARY ENERGY STORAGE AND ELECTRIC-VEHICLE PROPULSION. PROGRESS REPORT, OCTOBER--DECEMBER 1976. Nelson, P.A.; Yao, N.P.; Steunenberg, R.K.; Chilenskas, A.A.; Gay, E.C.; Battles, J.E.; Hornstra, F.; Miller, W.E.; Roche, M.F.; Shimotake, H. (Argonne National Lab., Ill. (USA)). Apr 1977. Contract W-31-109-ENG-38. 75p. Dep. NTIS, PC A04/MF A01.

These batteries are being developed for electric vehicle propulsion and for stationary energy storage applications. The present battery cells, which operate at 400 to 450°C, are of a vertically oriented, prismatic design with a central positive electrode of FeS or $FeS_2$, two facing negative electrodes of lithium--aluminum alloy, and an electrolyte of molten LiCl--KCl. Testing and evaluation of industrially fabricated cells is continuing. During this period, Li--Al/FeS and Li--Al/$FeS_2$ cells from Eagle-Picher Industries were tested, and tests of Li--Al/FeS cells from Gould Inc. were initiated. The cells are tested individually and in parallel and series battery configurations. These tests provide information on the effects of cell design modifications and alternative materials. Improved electrode and cell designs are being developed and tested at ANL, and the more promising designs are incorporated in the industrially fabricated cells. Among the concepts receiving major attention are carbon-bonded positive electrodes, scaled-up stationary energy storage cell designs, additives to extend electrode lifetime, and alternative electrode separators. The materials development efforts include the development of a new lightweight electrical feedthrough; investigations of new separator materials (e.g., $Y_2O_3$ powder, $Y_2O_3$ felt, and porous, rigid ceramics); corrosion tests of materials for cell components; and postoperative examinations of cells. The cell chemistry studies were directed to discharge mechanisms of FeS electrodes, emf measurements

of the LiAl/$FeS_2$ couple at various states of discharge, and studies of other transition-metal sulfides as positive-electrode materials. The advanced battery effort mainly concerned the use of calcium alloys for negative electrode and transition metal sulfides or oxides for the positive electrode. 13 figures, 18 tables.

624 (ANL--77-18) DEVELOPMENT OF LITHIUM/METAL SULFIDE BATTERIES AT ARGONNE NATIONAL LABORATORY: SUMMARY REPORT, 1976. (Argonne National Lab., Ill. (USA)). Mar 1977. Contract W-31-109-ENG-38. 38p. Dep. NTIS, PC A03/MF A01.

Highlights for 1976 of Argonne National Laboratory's program on the development of lithium/metal sulfide batteries are presented. The intended applications for these high-performance batteries are stationary energy storage for electric utility systems and electric vehicle propulsion. The battery cells consist of a lithium--aluminum alloys negative electrode, an FeS or $FeS_2$ positive electrode, and a molten LiCl--KCl electrolyte, which requires an operating temperature of 400--450°C. Most of the cells tested during the year were of a prismatic design, with capacities in the range of 100--150 Ah. Contracts were continued with three industrial firms on the development of cell fabrication techniques and the fabrication of cells, the development and fabrication of electrical feedthroughs and electrode separators, and a more general research and development effort on lithium/metal sulfide batteries. A design study was initiated on a 6 MWh battery module for stationary energy storage. A conceptual design for a 30-kW-hr electric-vehicle battery will serve as the basic design for the Mark I battery that is to be tested in a van. Engineering work has been concerned with the effects of modifications in cell designs and materials on performance and lifetime. The assembly of cells in the uncharged state was demonstrated successfully and found to offer some advantages. A large proportion of the effort was directed to the testing of industrially fabricated cells of various designs. Materials development studies have continued on electrical feedthroughs and new types of separators, including papers, felts and powders. Chemistry studies have involved alternative electrolyte compositions, liquid lithium electrodes, reaction mechanisms, and preparative methods for electrode materials. 7 figures, 1 table.

625 (ANL--77-35) HIGH-PERFORMANCE BATTERIES FOR STATIONARY ENERGY STORAGE AND ELECTRIC-VEHICLE PROPULSION. PROGRESS REPORT, JANUARY--MARCH 1977. Nelson, P.A.; Yao, N.P.; Steunenberg, R.K.; Chilenskas, A.A.; Gay, E.C.; Battles, J.E.; Hornstra, F.; Miller, W.E.; Roche, M.F.; Smimotake, H. (Argonne National Lab., Ill. (USA)). Jun 1977. Contract W-31-109-ENG-38. 83p. Dep. NTIS, PC A05/MF A01.

Research, development, and management activities of the program at Argonne National Laboratory (ANL) on lithium--aluminum/metal sulfide batteries during January to March 1977 are described. The present cells, which operate at 400 to 450°C, are of a vertically oriented, prismatic design with a central positive electrode of FeS or $FeS_2$, two facing negative electrodes of lithium--aluminum alloy, and an electrolyte of molten LiCl--KCl. A major objective of this program is to transfer the technology to industry. Testing and evaluation of industrially fabricated cells is continuing. During this period, Li--Al/FeS and Li--Al/$FeS_2$ cells were tested. These tests provide information on the effects of design modification and alternative materials for cells. Improved electrode and cell designs are being developed and tested. The materials development efforts include the development of a new, lightweight electrical feedthrough; studies of various current-collector designs; investigation of $Y_2O_3$ powder as separator material; wettability tests of materials for cell components; and postoperative examinations of cells. The cell chemistry studies were concerned with discharge mechanisms of FeS electrodes, with the mechanism of loss of sulfur and iron from $FeS_2$ electrodes, and with other transition-metal sulfides as positive electrode materials. The advanced battery effort investigated the use of calcium alloys for the negative electrode and the use of an iron current collector in the positive electrode. 19 figures, 16 tables.

626 (ANL--7745) LITHIUM/SELENIUM SECONDARY CELLS FOR COMPONENTS IN ELECTRIC VEHICULAR-PROPULSION GENERATING SYSTEMS. INTERIM TECHNICAL SUMMARY REPORT NO. 2, NOVEMBER 23, 1969--MAY 22, 1970. Cairns, E.J.; Gay, E.C.; Kolba, V.M.; Kyle, M.L.; Tevebaugh, A.D. (Argonne National Lab., Ill. (USA)). Nov 1970. Contract W-31-109-ENG-38. 86p. NTIS $3.00.

The battery program has as its ultimate goal the development of multi-kilowatt lithium/selenium secondary batteries for electrically driven Army vehicles. The shorter-term objective is to develop paste-electrolyte cells having lifetimes of 1000 to 2000 hours and 1000 to 2000 charge--discharge cycles.

627 (ANL--7863) LITHIUM/CHALCOGEN SECONDARY CELLS FOR COMPONENTS IN ELECTRIC VEHICULAR-PROPULSION GENERATING SYSTEMS. INTERIM TECHNICAL SUMMARY REPORT NO. 4, NOVEMBER 23, 1970--MAY 22, 1971. Gay, E.C.; Arntzen, J.D.; Cairns, E.J.; Kincina, J.E.; Riha, J.G. (Argonne National Lab., Ill. (USA)). Jan 1972. Contract W-31-109-ENG-38. 54p. NTIS $3.00.

ANL. LITHIUM;OXYGEN;SULFUR;SELENIUM; TELLURIUM;METAL-NONMETAL BATTERIES;LITHIUM-SULFUR BATTERIES;ELECTRIC-POWERED VEHICLES; RESEARCH PROGRAMS

628 (ANL--7998) DEVELOPMENT OF HIGH-SPECIFIC-ENERGY BATTERIES FOR ELECTRIC VEHICLES. PROGRESS REPORT, AUGUST 1972--JANUARY 1973. Cairns, E.J.; Nelson, P.A.; Gay, E.C.; Steunenberg, R.K.; Walsh, W.J. (Argonne National Lab., Ill. (USA)). Apr 1973. Contract W-31-109-eng-38. 98p. NTIS.

ELECTRIC-POWERED VEHICLES;RESEARCH PROGRAMS; AUTOMOBILES;LITHIUM-SULFUR BATTERIES;HALIDES; LITHIUM;METAL-NONMETAL BATTERIES;ELECTRIC BATTERIES

629 (ANL--7999) LITHIUM/CHALOGEN SECONDARY CELLS FOR COMPONENTS IN ELECTRIC VEHICULAR-PROPULSION GENERATING SYSTEMS. INTERIM TECHNICAL SUMMARY REPORT NO. 5, MAY 23, 1971--NOVEMBER 11, 1971. Walsh, W.; Gay, E.; Arntzen, J.; Kincinas, J.; Cairns, F. (Argonne National Lab., Ill. (USA)). Jan 1973. Contract W-31-109-ENG-38. 70p. NTIS.

METAL-NONMETAL BATTERIES;SELENIUM;SULFUR; TELLURIUM;ELECTRIC-POWERED VEHICLES;RESEARCH PROGRAMS

630 (ANL--8038) HIGH-PERFORMANCE BATTERIES

FOR OFF-PEAK ENERGY STORAGE. PROGRESS REPORT FOR THE PERIOD JANUARY--JUNE 1973. Nelson, P.A.; Walsh, W.J.; Steunenberg, R.K. (Argonne National Lab., Ill. (USA)). Mar 1974. Contract W-31-109-eng-38. 60p. Dep. NTIS $5.45.
Li--Al/LiCl--KCl/S--As--C. METAL-NONMETAL BATTERIES;ANL;RESEARCH PROGRAMS;LITHIUM ALLOYS; ALUMINIUM ALLOYS;LITHIUM CHLORIDES;POTASSIUM CHLORIDES;SULFUR;ARSENIC;CARBON;ELECTRODES; PLANNING;PERFORMANCE TESTING;OFF-PEAK ENERGY STORAGE

631 (ANL--8039) DEVELOPMENT OF HIGH-SPECIFIC-ENERGY BATTERIES FOR ELECTRIC VEHICLES. PROGRESS REPORT, FEBRUARY 1973--JULY 1973. Nelson, P.A.; Gay, E.C.; Steunenberg, R.K.; Battles, J.E.; Schertz, W.W.; Vissers, D.R.; Myles, K.M.; Kyle, M.L.; Webster, D.S.; Burris, L. (Argonne National Lab., Ill. (USA)). Dec 1973. Contract W-7405-109-eng-38. 47p. Dep. NTIS $5.45.
Li/S, 400°C. AUTOMOBILES;ELECTRODES;LITHIUM; SULFUR;HALIDES;LITHIUM COMPOUNDS;HIGH TEMPERATURE;DESIGN;ELECTRIC BATTERIES;ELECTRIC-POWERED VEHICLES;PERFORMANCE

632 (ANL--8057) HIGH-PERFORMANCE BATTERIES FOR OFF-PEAK ENERGY STORAGE. PROGRESS REPORT, JULY--DECEMBER 1973. Nelson, P.A.; Walsh, W.J.; Steunenberg, R.K.; Battles, J.E.; Shimotake, H.; Yao, N.P.; Tsai, H.C.; Martin, A.E.; Vissers, D.R.; Birk, J.R.; Myles, K.M.; Tuohig, W.D.; Webster, D.S.; Burris, L. (Argonne National Lab., Ill. (USA)). Nov 1974. Contract W-31-109-eng-38. 43p. Dep. NTIS $5.45.
Li--Al/LiCl--KCl/Fe sulfide, 400°C, 121 Whr/kg, brief testing of Li/LiCl--KCl/$Cu_2S$ cells. OFF-PEAK ENERGY STORAGE;LITHIUM-SULFUR BATTERIES;ELECTRIC-POWERED VEHICLES;DESIGN;HIGH TEMPERATURE;LITHIUM ALLOYS;ALUMINIUM ALLOYS; LITHIUM CHLORIDES;POTASSIUM CHLORIDES;IRON SULFIDES;ELECTRODES;MATERIALS TESTING; FABRICATION;COPPER SULFIDES;PERFORMANCE

633 (ANL--8058) DEVELOPMENT OF HIGH-SPECIFIC-ENERGY BATTERIES FOR ELECTRIC VEHICLES. PROGRESS REPORT, AUGUST 1973--JANUARY 1974. Nelson, P.A.; Gay, E.C.; Steunenberg, R.K.; Battles, J.E.; Schertz, W.W.; Vissers, D.R.; Myles, K.M.; Webster, D.S.; Burris, L. (Argonne National Lab., Ill. (USA)). Jun 1974. Contract W-31-109-eng-38. 35p. Dep. NTIS $4.00.
Li--$FeS_2$ with lithium halide-containing electrolyte. METAL-NONMETAL BATTERIES;HIGH TEMPERATURE;ELECTRIC-POWERED VEHICLES;DESIGN; PERFORMANCE TESTING;LITHIUM;IRON SULFIDES; LITHIUM CHLORIDES

634 (ANL--8064) HIGH-ENERGY BATTERY PROGRAM AT ARGONNE NATIONAL LABORATORY. Nelson, P.; Webster, D.S. (Argonne National Lab., Ill. (USA)). Apr 1974. Contract W-31-109-eng-38. 24p. Dep. NTIS $4.00.
Li--Al/LiCl--KCl/$FeS_2$. LITHIUM ALLOYS; ALUMINIUM ALLOYS;LITHIUM CHLORIDES;POTASSIUM CHLORIDES;IRON SULFIDES;METAL-NONMETAL BATTERIES;ANL;RESEARCH PROGRAMS;ELECTRIC-POWERED VEHICLES;PERFORMANCE;ELECTRODES;DESIGN; FABRICATION;OFF-PEAK ENERGY STORAGE

635 (ANL--8109) HIGH-PERFORMANCE BATTERIES FOR OFF-PEAK ENERGY STORAGE AND ELECTRIC-VEHICLE PROPULSION. PROGRESS REPORT FOR THE PERIOD JANUARY--JUNE 1974. (Argonne National Lab., Ill. (USA)). Jan 1975. Contract W-31-109-eng-38. 136p. Dep. NTIS $5.45.
Li--Al/LiCl--KCl/$FeS_2$; ANL. LITHIUM-SULFUR BATTERIES;RESEARCH PROGRAMS;ANL;OFF-PEAK ENERGY STORAGE;ELECTRIC-POWERED VEHICLES;OPERATION; ELECTRODES;PERFORMANCE;FABRICATION;TESTING; ELECTROCHEMISTRY;DESIGN;LITHIUM;ALUMINIUM; LITHIUM CHLORIDES;POTASSIUM CHLORIDES;IRON SULFIDES

636 (ANL-K--76-3541-1) DESIGN AND COST STUDY OF NICKEL--ZINC BATTERIES FOR ELECTRIC VEHICLE. FINAL REPORT. Klein, M.; Dube, D. (Argonne National Lab., Ill. (USA)). 1 Oct 1976. Contract W-31-109-ENG-38;SUB-31-109-38-3541. 132p. Dep. NTIS, PC A07/MF A01.
A battery module configuration consisting of four 325-Ah cells was selected. Twelve such modules would make up a 24-kWh battery. The key design parameter is operation current density. An energy density of 2.1 Wh/in.$^3$ and 35 Wh/lb was obtained. A flow diagram was drawn for the manufacturing process. An eight-month period would be required to set up a pilot plant. The material requirements for 100,000 batteries per year would not have a significant impact on current U.S. consumption. 29 figures, 28 tables (RWR)

637 (ANL-K--76-3543-1) DESIGN AND COST STUDY OF A ZINC/NICKEL OXIDE BATTERY FOR ELECTRIC VEHICLE PROPULSION. FINAL REPORT. (Yardney Electric Corp., Pawcatuck, Conn. (USA)). Oct 1976. Contract W-31-109-ENG-38; Sub-31-109-38-3543. 118p. Dep. NTIS, PC A06/MF A01.
A preliminary design and cost study of a zinc/nickel oxide battery suitable for electric vehicle propulsion was conducted with the objectives of verification of zinc/nickel oxide battery state-of-technology, projection of the state-of-technology battery manufacturing processes, including capital facility requirements, at pilot plant and production plant levels of operation, and recommendation of a preliminary test procedure and standards. A state-of-technology four-cell zinc/nickel oxide battery module is specified having the following principal characteristics: Capacity (C/2 rate), 310 Ah; Voltage, 6.4 V; Total energy content (C/2 rate), 1.98 kWh; Weight, 26.4 kg; Specific energy (C/2 rate), 75 Wh/kg; Specific power (sustaining; peak), 68 W/kg; 250 W/kg; Cycle life (60 percent depth at C/2 rate), 500. Battery manufacturing processes and costs are defined for initial pilot production of the state-of-technology zinc/nickel oxide battery at 1000 25-kWh batteries per year to final pilot production of the advanced technology unit at 5000 25-kWh batteries per year. Production of the advanced technology battery in a highly automated dedicated facility is then defined for plant capacity developing from 10,000 to 100,000 25-kWh batteries per year. This volume could be reached in 1986; the product would cost $34/kWh. Preliminary test procedures and standards for cells and batteries were defined including evaluation of basic performance, environmental effects and safety, by means of a comprehensive test matrix. 14 figures, 10 tables.

638 (ANL-K--77-3542-1) ELECTRIC VEHICLE PROPULSION BATTERIES: DESIGN AND COST STUDY FOR NICKEL/ZINC BATTERY MANUFACTURE. TASK A. (Eagle-Picher Industries, Inc., Joplin, Mo. (USA). Couples Dept.). 1977. Contract W-31-109-ENG-38. 85p. Dep. NTIS, PC A05/MF A01.
For satisfying the 25-kWh energy requirement necessary for vehicle propulsion, a 700-pound nickel--zinc battery was configured. Containing 64 individual cells, the unit was selected for minimum weight from computed packaging

possibilities. Unit volume was projected to be 4.77 cubic feet. Capacity of the cells delivering 100+ volts was set at 245 ampere-hours. Selection was made primarily because of the compatibility with expressed vehicle requirements of a lower-current system. Manufacturing costs were computed for a unit using sintered positive electrodes at $86/kWh, pilot plant rate, and $78/kWh, production plant rate. Based on a lower than anticipated cost differential between sintered and nonsintered positive electrodes and certain other performance differences, the sintered electrode was chosen for the battery design. Capital expenditures for a production rate of 10,000 batteries per year are estimated to be $2,316,500. Capital expenditure for demonstrating production rates in a pilot plant facility is approximately $280,000, with the use of some shared available equipment. 29 figures, 9 tables.

639 (ANL-K--77-3558-1) DEVELOP NICKEL--ZINC BATTERY SUITABLE FOR ELECTRIC VEHICLE PROPULSION. TASK A: DESIGN AND COST STUDY. (Gould, Inc., Rolling Meadows, Ill. (USA). New Business Div.). 15 Feb 1977. Contract W-31-109-ENG-38;SUB-31-109-3558. 127p. Dep. NTIS, PC A07/MF A01.

A three-month design and cost study for the use of nickel--zinc batteries in electric vehicles is presented. Battery configuration is analyzed, and expected performance is set forth. Current development problems concern component materials and capacity decline on cycling, electrolyte maintenance, and thermal characteristics. The manufacturing process is outlined, and estimates are made for cost, materials requirements, capital needs, etc. 61 figures, 24 tables. (RWR)

640 (ANL-K--77-3621-1(Vol.1)) COST AND DESIGN STUDY FOR ELECTRIC VEHICLE LEAD--ACID BATTERIES. (ESB, Inc., Philadelphia, Pa. (USA)). 1977. Contract W-31-109-ENG-38;31-109-38-3621. 441p. Dep. NTIS, PC A19/MF A01.

A design and cost study for electric-vehicle lead--acid batteries is presented; a research and development program leading to demonstration and testing of 20- to 30-kWh batteries is proposed. Both flat pasted and tubular positive electrodes are included. Detailed testing programs are set forth. 110 figures, 8 tables (RWR)

641 (ANL-K--77-3624-1) DESIGN AND COST STUDY FOR DEVELOPMENT OF LEAD--ACID BATTERIES SUITABLE FOR ELECTRIC VEHICLE PROPULSION. FINAL REPORT. Weinlein, C.E. (Globe-Union, Inc., Milwaukee, Wis. (USA)). 1977. Contract W-31-109-ENG-38. 126p. Dep. NTIS, PC A07/MF A01.

A design for an improved state-of-the-art (ISOA) battery is proposed in this report. It is believed that this ISOA design is the most efficient design achievable within the constraints of the ISOA battery development program. These constraints include realistic time and financial limitations, and compatibility with existing high-speed production equipment. The ISOA battery is in fact an improved, state-of-the-art lead--acid battery suitable for use in an electric vehicle. A durable, light-weight polypropylene container and cover complete with single-point watering and venting features are incorporated in the ISOA design. A number of materials and process parameters with profound affect on battery performance will be chosen only after extensive evaluation and cell testing. Development of an advanced lead--acid electric vehicle battery will involve the evaluation and application of effective forward concepts in the design of the battery. Many weight-saving designs will be incorporated. Significant improvements in active material efficiencies and integrity are required. The goals of 60 Wh/kg and 1000 life cycles are ambitious but achievable. The cycle life goal appears to be the most formidable. Investigations of charging equipment and parameters will be undertaken. The impact of manufacturing plants on the environment and natural resources is discussed. 3 figures, 23 tables. (RWR)

642 (APTD--1126) DEVELOPMENT OF HIGH-ENERGY BATTERIES FOR ELECTRIC VEHICLES. PROGRESS REPORT FOR THE PERIOD FEBRUARY 1969--JUNE 1970. Cairns, E.J.; Kyle, M.L.; Maroni, V.A.; Shimotake, H.; Steunenberg, R.K.; Tevebaugh, A.D. (Argonne National Lab., Ill. (USA)). Jul 1970. 60p. (PB--197576). Dep. NTIS $4.25.

Lithium halide electrolytes, Li in S or phosphorus sulfide cathodes; 0.5 A-h/cm$^2$ at 0.5 A/cm$^2$. LITHIUM-SULFUR BATTERIES;ELECTRIC-POWERED VEHICLES;PERFORMANCE;CORROSION;ELECTRIC CURRENTS;TEMPERATURE DEPENDENCE;GEOMETRY; ELECTRIC POTENTIAL;LITHIUM FLUORIDES;LITHIUM CHLORIDES;LITHIUM IODIDES;LITHIUM BROMIDES; RUBIDIUM BROMIDES;PHOSPHORUS SULFIDES

643 (APTD--1345) DEVELOP HIGH CHARGE AND DISCHARGE RATE LEAD/ACID BATTERY TECHNOLOGY. FINAL REPORT. (TRW Systems Group, Redondo Beach, Calif. (USA)). Apr 1972. Contract 68-04-0028. 168p. NTIS.

LEAD-ACID BATTERIES;RESEARCH PROGRAMS;HYBRID ELECTRIC-POWERED VEHICLES;DESIGN;OPTIMIZATION; PERFORMANCE

644 (APTD--1346) LEAD/ACID BATTERY DEVELOPMENT FOR HEAT ENGINE/ELECTRIC HYBRID VEHICLES. FINAL REPORT. Giner, J.; Taylor, A.H.; Goebel, F. (Tyco Labs., Inc., Waltham, Mass. (USA)). Nov 1971. Contract EHSH 71-009. 193p. NTIS.

AUTOMOBILES;ELECTRIC MOTORS;HYBRID ELECTRIC-POWERED VEHICLES;ELECTRIC-POWERED VEHICLES;LEAD-ACID BATTERIES;ELECTRIC BATTERIES;DESIGN; CORROSION;TESTING;COST;MECHANICAL TESTS

645 (APTD--1346) LEAD/ACID BATTERY DEVELOPMENT FOR HEAT ENGINE/ELECTRIC HYBRID VEHICLES. FINAL REPORT. Giner, J.; Taylor, A.H.; Goebel, F. (Tyco Labs., Inc., Waltham, Mass. (USA)). Nov 1971. Contract EHSH-71-009. 203p.

LEAD-ACID BATTERIES;HYBRID ELECTRIC-POWERED VEHICLES;DESIGN;ELECTROCHEMISTRY;CORROSION; MECHANICAL TESTS;LIFETIME;PLATES;ELECTRODES; COST;TESTING

646 (BM-RI--3078) DIATOMITE AS A FILLER IN BATTERY BOXES. Hatmaker, P. (Bureau of Mines, Washington, D.C. (USA)). 1931. 2p. TIC.

Report briefly discusses the use of diatomite, and lists manufacturers of battery boxes.

647 (CONF-691143--, pp 375-391) SECONDARY LITHIUM--SULFUR BATTERY. Heredy, L.A.; Yao, N.P.; Saunders, R.C. Nov 1969.

From 1. international electric vehicle symposium; Phoenix, Arizona, USA (5 Nov 1969). International electric vehicle symposium. Design work on lithium--sulfur battery (and

others). ELECTRIC-POWERED VEHICLES;AUTOMOBILES; PERFORMANCE;LITHIUM-SULFUR BATTERIES;HIGH TEMPERATURE;CATHODES;CORROSION;DESIGN; POLARIZATION;EFFICIENCY;TEMPERATURE DEPENDENCE; COST;OFF-PEAK ENERGY STORAGE;NICKEL-ZINC BATTERIES;ZINC-AIR BATTERIES;METAL-GAS BATTERIES;SODIUM;AIR

648 (CONF-691143--, pp 392-415) LITHIUM/ SULFUR CELLS AND THEIR POTENTIAL FOR VEHICLE PROPULSION. Shimotake, H.; Kyle, M.L.; Maroni, V.A.; Cairns, E.J. Nov 1969.
From 1. international electric vehicle symposium; Phoenix, Arizona, USA (5 Nov 1969).
International electric vehicle symposium.
LITHIUM-SULFUR BATTERIES;ELECTRIC-POWERED VEHICLES;DESIGN;CATHODES;HIGH TEMPERATURE; ELECTRIC POTENTIAL;CURRENT DENSITY;ELECTROLYTES; AUTOMOBILES;SPECIFICATIONS;PERFORMANCE

649 (CONF-710233--, pp 26p, Paper 13) RESEARCH AND DEVELOPMENT ON A LITHIUM--SULFUR BATTERY. Cairns, E.J. (Argonne National Lab., IL). 1971.
From Conference on low pollution power systems development; Eindhoven, Netherlands (23 Feb 1971).
Technical report of the conference on low pollution power systems development.
Desired performance characteristics. LITHIUM-SULFUR BATTERIES;AUTOMOBILES;ELECTRIC-POWERED VEHICLES;DESIGN;PERFORMANCE;ELECTRIC POTENTIAL; LITHIUM BROMIDES;RUBIDIUM BROMIDES

650 (CONF-711166--, pp 482-501) ANALYSIS OF THE SODIUM--SULFUR BATTERY IN TRACTIVE POWER APPLICATIONS. Christopher, H.A. Nov 1971.
From 2. international electric vehicle symposium; Atlantic City, New Jersey, USA (8 Nov 1971).
International electric vehicle symposium.
An analytical program was begun to determine the performance characteristics of the sodium--sulfur battery in vehicular propulsion service. Because of the need for a solid electrolyte of finite thickness, hermetic seals, thermal insulation, and other novel features of construction which could result in a relatively large amount of inert battery weight, a complete design optimization of the sodium--sulfur system was necessary. The basic engineering considerations and techniques associated with optimizing the overall battery design and computing the resulting performance parameters are the basis of this study. Small sodium--sulfur test cells of about 1 amp-hour capacity were designed, constructed, and evaluated to establish a mathematical model which characterizes the basic cell. A computer program was then devised to seek the optimum battery design. The results indicate that a 10- to 50-kW sodium--sulfur system could be optimized by proper design to achieve better than 100 Wh/lb at the 3- to 4-hour discharge rate. This optimum cell design calls for 0.5-cm-diameter electrolyte tubes, having an active length of about 20 cm, to be arranged in two or three columns within each individual cell operating at an average voltage of about 1.8 volts. Such a battery, weighing less than 1000 pounds and installed in a typical American compact car, would provide a 200-mile range capability at 65 mph with no significant sacrifice in the vehicle's presently accepted level of performance at lower speeds. 12 figures, 7 tables (RWR)

651 (CONF-711166--, pp 531-539) HIGH PERFORMANCE ZINC--BROMINE SECONDARY BATTERY SYSTEM. Zito, R. Jr. Nov 1971.
From 2. international electric vehicle symposium; Atlantic City, New Jersey, USA (8 Nov 1971).
International electric vehicle symposium.
Advantages of a zinc--bromine system are set forth. The batteries are constructed in a bipolar array configuration. The zinc bromide electrolyte in each cell is confined between two inert plates. During charging, Zn is deposited on the anode surface and bromine is deposited in the cathode structure. During discharge there are no mechanical or chemical changes to the inert electrodes. The Zn--Br couple produces 1.8 V per cell at open circuit. Considerable design latitude is possible in the usual trade-offs between drain rate vs charge retention and energy density vs power density. High-power cells were built and tested to demonstrate the potential for use in hybrid electric automobiles and other applications. Power densities of 130 to 140 W/lb can be attained at energy densities of 4 to 5 Wh/lb. The relatively high self-discharge rate must be considered in battery design. Projected costs are of the order of $65/kWh. 4 figures (RWR)

652 (CONF-711166--, pp 739-743) ZINC--AIR BATTERIES. Keller, M. Nov 1971.
From 2. international electric vehicle symposium; Atlantic City, New Jersey, USA (8 Nov 1971).
International electric vehicle symposium.
A zinc--air battery is being developed for use in a Renault model R10. The battery itself, a small experimental test cell, and the completed vehicle are described. The car is expected to have a range of 160 miles between changes at 45 mph. 3 figures. (RWR)

653 (CONF-740805--7) DEVELOPMENT OF LITHIUM/ SULFUR CELLS FOR APPLICATION TO ELECTRIC AUTOMOBILES. Gay, E.C.; Schert, W.W.; Martino, F.J.; Anderson, K.E. (Argonne National Lab., Ill. (USA)). 1974. 26p. Dep. NTIS $4.50.
From 9. Intersociety Energy Conversion Engineering Conference; San Francisco, California, USA (26 Aug 1974).
Li/LiCl--KCl/$FeS_2$. METAL-NONMETAL BATTERIES; LITHIUM;LITHIUM CHLORIDES;POTASSIUM CHLORIDES; IRON SULFIDES;HIGH TEMPERATURE;ELECTRIC-POWERED VEHICLES;ELECTRODES;PERFORMANCE;DESIGN

654 (CONF-750123--1) EVALUATION OF LITHIUM/ SULFUR BATTERIES FOR AUTOMOBILES. Nelson, P.A. (Argonne National Lab., Ill. (USA)). [nd]. Contract W-31-109-eng-38. 32p. Dep. NTIS $4.75.
From Contractors coordination meeting; Cambridge, Massachusetts, USA (15 Jan 1975).
LITHIUM-SULFUR BATTERIES;AUTOMOBILES;BATTERY CHARGERS;BATTERY CHARGING;COMPUTER CALCULATIONS; FEASIBILITY STUDIES;ELECTRIC-POWERED VEHICLES

655 (CONF-760416--2) APPLICATIONS AND PROSPECT OF ENERGY STORAGE BATTERIES. Yao, N.P. (Argonne National Lab., Ill. (USA)). 1976. Contract W-31-109-eng-38. 4p. Dep. NTIS $3.50.
From IEEE region six conference; Tucson, Arizona, USA (7 Apr 1976).
The major incentive for the U. S. to develop commercial-scale batteries and other efficient storage systems is the potential saving of petroleum and natural gas. Storing the off-peak energy derived from coal and nuclear base generating plants and discharging it during the periods of high demand is the concept contemplated for electric utility application. Wide use of electric vehicles in big cities and

urban areas for the improvement of air quality is another incentive. This paper addresses three key areas: the technical and economic requirements of batteries for applications to electric utility and to electric vehicles, the current development status of battery technology in the U. S. and the level of development efforts, and the prospects and the schedule for implementing the advanced battery technology. 1 table. (RWR)

656 (CONF-760617--3) DESIGN AND PERFORMANCE OF LI--AL/IRON SULFIDE CELLS FOR UTILITY ENERGY STORAGE AND ELECTRIC VEHICLES. Ivins, R.O.; Gay, E.C.; Walsh, W.J.; Chilenskas, A.A. (Argonne National Lab., Ill. (USA)). 1976. Contract W-31-109-ENG-38. 27p. Dep. NTIS $4.00.

From 27. power sources symposium; Fort Monmouth, New Jersey, USA (21 Jun 1976).

The design, development, and testing of laboratory and engineering-scale Li--Al/iron sulfide cells at Argonne National Laboratory are described. The effort is directed toward the development of batteries suitable for utility energy storage and electric automobile propulsion. Results of testing of laboratory-scale cells of prismatic configuration (16 to 200 $cm^2$ electrode area) having electrodes fabricated by hot-pressing, electrochemical formation, or vibratory loading are presented. Prismatic cells were operated with specific energies of 115 W-h/kg at the 10-h discharge rate and specific powers of 140 W/kg at full charge and 100 W/kg at 50 percent discharge. Higher performance can be expected from improved cell designs which increase the ratio of electrode and active material weight to total cell weight, replacement of the ceramic fabric separators presently used by ceramic paper separators, and development of cells with lower electrical resistance. In order to involve industry early in the development effort, contracts to develop fabrication techniques for electrodes and cells were made by Argonne in 1975 with several industrial firms. Industry provides the fabrication development, while Argonne continues to develop the system to reach the program goals. This paper describes the choice of electrode fabrication techniques and cell designs for the second round of industrial contracts. The design and performance testing of the cells to date suggest that the technical program goals for both applications can be met. Testing of full-scale, industrially fabricated cells in battery configurations will be completed in the next two years. Full-scale batteries demonstrating technical and economic goals are expected in about 1981. 3 figures, 4 tables.

657 (CONF-760866--2) DESIGN AND TESTING OF LITHIUM/IRON SULFIDE BATTERIES FOR ELECTRIC VEHICLE PROPULSION. Chilenskas, A.A.; Bernstein, G.J.; Graae, J.E.A.; Hornstra, F.; Slawecki, M.A.; Kolba, V.; Ivins, R.O. (Argonne National Lab., Ill. (USA)). 1976. Contract W-31-109-ENG-38. 33p. Dep. NTIS $4.00.

From 4. international electric vehicle symposium; Dusseldorf, F.R. Germany (31 Aug 1976).

A program to develop high-performance batteries for use in electric automobiles and for storing off-peak energy for load leveling in electric utility systems is described. The batteries for vehicle propulsion consist of cells with a central positive plate containing $FeS_2$ and two facing negative plates containing Li--Al alloy. The electrolyte is the LiCl--KCl eutectic which has a melting point of 352°C and requires the cells to be operated at temperatures between 350 and 450°C. Prismatic cells 13 cm on a side and 2 to 4 cm thick were fabricated. Laboratory cells demonstrated a capacity at the 10-hour rate of about 120 Ah at 1.5 V, which corresponds to a specific energy of about 150 W-hr/kg. A battery testing laboratory was established which contains equipment for charging and discharging the cells in a mode that simulates the operation of the cells in an electric vehicle battery. Equipment was developed for equalizing the charge in an array of cells; it was tested successfully with lead--acid batteries as well as Li--Al/$FeS_2$ batteries. A cell charge equalization system suitable for incorporation in a vehicle propulsion battery was also developed. Calculations and experimental measurements were made to determine resistances of the various internal and external cell and battery components. Designs were developed for a 30 kWh vehicle battery suitable for driving a small four-passenger vehicle. The battery design is based upon the use of 160 prismatic sub-cells, 13 x 20 cm, which are arranged in two parallel rows. Adjacent sub-cells are connected in series. The battery is contained in an enclosure which is designed to minimize heat loss during idle periods and remove excess heat generated during operating periods. 10 figures, 4 tables.

658 (CONF-770531--6) MIGRATIONAL POLARIZATION IN HIGH-CURRENT DENSITY MOLTEN SALT ELECTROCHEMICAL DEVICES. Braunstein, J.; Vallet, C.E. (Oak Ridge National Lab., Tenn. (USA)). 1977. Contract W-7405-ENG-26. 16p. Dep. NTIS, PC A02/MF A01.

From Meeting of the Electrochemical Society; Philadelphia, Pennsylvania, USA (8 May 1977).

Electrochemical flux equations based on the thermodynamics of irreversible processes have been derived in terms of experimental transport coefficients for binary molten salt mixtures analogous to those proposed for high temperature batteries and fuel cells. The equations and some numerical solutions indicate steady state composition gradients of significant magnitude. The effects of migrational separation must be considered along with other melt properties in the characterization of electrode behavior, melt composition, operating temperatures and differences of phase stability, wettability and other physicochemical properties at positive and negative electrodes of high current density devices with mixed electrolytes.

659 (CONF-7610115--, pp 19-29) MARKETING AND MAINTENANCE-FREE BATTERIES. Stoll, R.W. 1976.

From 39. annual convention of the Independent Battery Manufacturers Association, Inc.; Chicago, Illinois, USA (6 Oct 1976).

IBMA 39th annual convention.

This nontechnical article discusses the reasons for the development and popularity of ''maintenance-free'' batteries. Results of marketing interviews with users of maintenance-free batteries are included. (RWR)

660 (CONF-7610115--, pp 30-35) PRODUCT LIABILITY: LEGAL IMPLICATIONS, WASHINGTON ACTIVITY UPDATE, ''GOING BARE''. Halfpenny, H.; Marchese, L. (Halfpenny, Hahn and Roche, Chicago). 1976.

From 39. annual convention of the Independent Battery Manufacturers Association, Inc.; Chicago, Illinois, USA (6 Oct 1976).

IBMA 39th annual convention.

The present situation with respect to product liability is described in general and

in regard to battery manufacturers in particular. Background on the development of the present situation is given. Recommendations as to things to be done or not to be done are set forth. The significance of insurance is emphasized. (RWR)

661 (CONF-7610115--, pp 41-52) POLLUTION CONTROL AND SAFETY WORKSHOP. Hahn, L.W. (Chloride Inc., Tampa, FL). 1976.
From 39. annual convention of the Independent Battery Manufacturers Association, Inc.; Chicago, Illinois, USA (6 Oct 1976).
IBMA 39th annual convention.
The workshop included two films, on the construction, maintenance, and purpose of bag house collectors and on proper hood design, and a number of exhibits. Most of these exhibits are included in this summary. They may be listed as follows: bag house specifications; relative properties of popular fibers; costs of bag houses and associated equipment; ventilation design and testing equipment; contractors bid specifications; and local exhaust ventilation design objectives. Instrumentation for measuring lead content in air and for collecting dust was discussed. (RWR)

662 (CONF-7610115--, pp 54-62) HEALTH AND SAFETY. Scheinbaum, L. 1976.
From 39. annual convention of the Independent Battery Manufacturers Association, Inc.; Chicago, Illinois, USA (6 Oct 1976).
IBMA 39th annual convention.
Two aspects of health and safety are considered, personal and plant hygiene and specific methods of blood and air sampling. Elaborate ventilation systems may not reduce problems of lead in air unless a comprehensive personal and plant hygiene program is in effect and the employees understand and take an active interest in the program. Descriptions of nine slides used in this presentation are given, as well as those of the 33 slides used in describing the blood/lead program. (RWR)

663 (CONS/1205--1) ENGINEERING STUDY OF A 20 MW LEAD--ACID BATTERY ENERGY STORAGE DEMONSTRATION PLANT. FINAL REPORT FOR THE PERIOD ENDING OCTOBER 1976. (Bechtel Power Corp., San Francisco, Calif. (USA)). Oct 1976. Contract EY-76-C-03-1205. 226p. Dep. NTIS, PC A11/MF A01.
The Research and Engineering Operation of Bechtel Corporation conducted an engineering study of a 20-MW lead--acid battery energy storage demonstration plant. Ten alternative designs were evaluated. Basically, the configurations proposed for the demonstration plants are those of the mature plants which would follow. The designs of the individual plants are based on the cell designs and the means used to house the cells. Initially, proposed cell designs from five manufacturers were considered. To conform with the level of effort allowed for this engineering study, two manufacturers' cells (one open-tank design and one sealed cell design) were selected by ERDA and Bechtel as being representative. These designs formed the basis for the detailed evaluation conducted in this study. The plant and battery configurations evaluated in the study are a large open-tank cell, configured in rows and housed in four buildings; a sealed cell, configured in a single layer of close packed rows in a single building; a sealed cell, configured in a three-tiered arrangement in a single building; and a sealed cell, configured with groups of cells housed in weatherproof modules and placed outdoors. Annual operating costs based on these mature plant costs show lead--acid load-leveling plants are generally not economically competitive with the alternatives when no consideration is given to their other possible benefits to the power system. However, application of credits (e.g., transmission line or spinning reserve credits) can make such plants economically competitive with gas turbine peaking units in specific situations. 46 figures, 25 tables. (RWR)

664 (CONS/2114--1) EXECUTIVE SUMMARY STUDY OF LEAD-ACID BATTERY SYSTEMS FOR PEAKING POWER. FINAL REPORT FOR THE PERIOD ENDING OCTOBER 1976. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA)). Dec 1976. Contract EX-76-C-01-2114. 16p. Dep. NTIS, PC A02/MF A01.
A study of lead-acid batteries for peaking power applications and the auxiliaries required for an operable system has been completed. The results of the study are presented in a three-volume report. The present volume summarizes the salient points and conclusions derived from the study. 3 figures, 4 tables. (RWR)

665 (CONS/2114--2) STUDY OF THE MANUFACTURING COSTS OF LEAD--ACID BATTERIES FOR PEAKING POWER. FINAL REPORT FOR THE PERIOD ENDING OCT. 1976. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA)). Dec 1976. Contract EX-76-C-01-2114. 65p. Dep. NTIS, PC A05/MF A01.
A detailed study was made of a postulated 1000-MWh per year lead--acid battery business dedicated to supplying a single design of 40-MWh peaking power batteries to electric utilities. State-of-the-art industrial technology is assumed, but the manufacturing facility and business organization is tailored to the one product. Analysis of the product costs and business expenses associated with such an operation indicates that substantially lower selling prices can be realized as compared with normal industrial battery pricing. Under the low-risk conditions assumed, the selling price would be $36.90/kWh at the 4-h rate. Advanced technology would reduce the cost to $31.62/kWh. 21 figures, 31 tables. (RWR)

666 (COO--2520-2) LOW TEMPERATURE LITHIUM/SULFUR SECONDARY BATTERY. ANNUAL PROGRESS REPORT, DECEMBER 1, 1974--DECEMBER 1, 1975. Brummer, S.B.; Rauh, R.D.; Marston, J.M.; Shuker, F.S. (EIC Corp., Newton, Mass. (USA)). Apr 1976. Contract EY-76-C-02-2520. 66p. Dep. NTIS $4.50.
The purpose of this program is to develop an ambient-temperature Li/S secondary battery. The proposed configuration is Li/organic electrolyte, dissolved S/catalytic electrode or current collector. This battery will have an energy density of 100 Wh/lb, including the weight of cell hardware. Investigations of S solubility and electrochemistry have been undertaken in polar, aprotic nonaqueous solvents, chosen for their stability toward Li. Highest S solubility was achieved if S was dissolved in the form of Li polysulfides, $Li_2S$/sub n/. Highest S solubilities were achieved in dimethyl sulfoxide (DMSO) and tetrahydrofuran (THF), where 9--10M S solutions were obtained as $Li_2S_{9-10}$. The solutions of highest S concentrations were most readily prepared through the direct reaction of $S_8$ with $Li_2S$ in the presence of the solvent. The discharge and charge capacities of such solutions, 1--2M in S, were measured galvanostatically between preset limits of 1 and 3.7V (vs. Li). Two

plateaus were observed in DMSO, at 2.7V and at 2.2V. Discharge capacities of approximately 0.25 e⁻/S were observed in THF and in methyl acetate. Recharge generally occurred between 2.5 and 3.0V. In DMSO, experiments showed that $S_8$ or $S_8^{-2}$ could not be reduced on C below $S_4^{-2}$, positive of 1.0V vs. $Li^+/Li$. However, $S^{-2}$ and $S_4^{-2}$ could be readily oxidized on C up to $S^{-2}$/sub n greater than 10/, withoutthe formation of (insoluble) $S_8$. Only $S_8^{-2}$ gave $S_8$ precipitation upon oxidation. It was concluded that the cycling capacity of the dissolved $Li_2S$ cathode was limited by the reduction of $S^{-2}$/sub n < 4/ on C. Other studies indicate that rechargeability of the negative will not be a special problem. 20 figures, 5 tables.

667 (COO--2564-1) BASIC RESEARCH ON CERAMIC MATERIALS FOR ENERGY STORAGE AND CONVERSION SYSTEMS. PROGRESS REPORT, APRIL 1, 1975--NOVEMBER 30, 1975. Whitmore, D.H. (Northwestern Univ., Evanston, Ill. (USA)). Dec 1975. Contract E(11-1)-2564. 7p. Dep. NTIS $3.50.

The present research program involves utilizing appropriate probes for movement of ionic and electronic charge carriers in ceramic materials suitable for solid electrolyte and electrode applications in high-performance, secondary battery and fuel cell systems. Special emphasis is placed on developing a better understanding of the effects of structure, impurities, and composition on transport mechanisms and on developing detailed knowledge of the kinetics and mechanisms of reactions occurring (on a microscopic scale) at the electrode--electrolyte interfaces of energy storage and conversion systems. (auth)

668 (COO--2565-4) SODIUM--SULPHUR BATTERY SYSTEM. ANNUAL REPORT, MAY 19, 1975--MAY 19, 1976. Levine, C.A. (Dow Chemical U.S.A., Walnut Creek, Calif.). 1 Nov 1976. Contract EY-76-C-02-2565. 68p. Dep. NTIS, PC A04/MF A01.

The development of the hollow-glass-fiber sodium--sulfur battery progressed significantly. Glass fiber quality improved greatly, and the fiber spinning and assembly machinery was made capable of more uniform operation. Impurities in the sulfur, including H, C, $Zn^{++}$, and $Al^{+++}$, do not appear to affect cell lifetime, while impurities in the Na are important. The Ca and ''oxide'' contents of the Na must be held to low levels. Corrosion products of a 316 stainless steel case are harmless to at least 75-day lifetimes. The Mg content of aluminum alloys can leach out in the catholyte and cause cell resistance to increase. Lifetime does not seem to be a function of total current passed or current density across the fibers. On 1000-fiber, 0.5-Ah cells, over 1400 deep charge--discharge cycles were achieved in 75 days of operating life. A larger 5-Ah cell went through 130 cycles at over 80 percent depth. Cell resistance and capacity remained constant, even at the $^1/_2$ hour rate. At lesser depths of discharge, the cells lasted longer. Failure was usually in the fibers when ''dirty'' Na was used, and usually just below the tube sheet when ''clean'' Na was used. An updated estimate of ''cost for sale'' of the bare cell is approximately $23.15 per kWh, based on 0.8-kWh cells. 21 figures, 3 tables.

669 (ECOM--0227-F) LOW POWER METAL HYDRIDE FUEL CELL/BATTERY HYBRID SYSTEMS. Baker, B.S.; Camp, R.N. (Energy Research Corp., Bethel, Conn. (USA)). Jan 1975. Contract DAAB-07-73-C-0227. vp. NTIS.

Steady 2 mA at 32 V or 430 mA-60 ms pulses at 24 V. HYDROGEN FUEL CELLS;OXYGEN;HYDROGEN PEROXIDE;CALCIUM HYDRIDES;INVERTERS;NICKEL-CADMIUM BATTERIES;DESIGN;PERFORMANCE;HYBRID SYSTEMS;DECOMPOSITION

670 (ECOM--0272-F-72) SECONDARY ZINC--OXYGEN BATTERIES. Klein, M. (Energy Research Corp., Bethel, Conn. (USA)). Nov 1973. Contract DAAB-07-72-C-0272. 46p. NTIS.

6v, 25 A-hr; selection of materials. ZINC-AIR BATTERIES;BATTERY SEPARATORS;ANODES; OPTIMIZATION;CATHODES;DESIGN;FABRICATION; TESTING;ELECTRODES

671 (EPRI--116) DEVELOPMENT OF LITHIUM--METAL SULFIDE BATTERIES FOR LOAD LEVELING. Hall, J.; Lai, S.C.; McCoy, L.; Saunders, R. (Rockwell International Corp., Canoga Park, Calif. (USA)). Jun 1975. 46p. Dep. NTIS, PC A03/MF A01.

A multi-element project directed to the development of a lithium--iron sulfide battery for electric utility energy storage is described. This battery uses a molten KCl--LiCl electrolyte and is operated at about 400°C. This report describes the work performed on iron sulfide positive electrodes during the period of April 1 to December 30, 1974. The status of associated elements of the project concerned with lithium negative electrodes, ceramic components, and cell design is also presented. Investigations of iron sulfide active materials, current-conductive matrices, and electrode housings were made with the objective of developing low-cost, long-lived iron sulfide electrodes. A number of small electrodes using $FeS_{1.5}$ (FeS and $FeS_2$) were cycled to complete discharge at the C/10 rate for up to 100 cycles without loss of capacity and with active material utilizations and Coulombic efficiencies approaching 100 percent. Capacities of 0.6 Ah/cm³ of electrode void volume were easily attained. An FeS electrode prepared from $Li_2S$ and iron powder in excess performed well. The iron sulfide electrodes were tested in cells using liquid lithium negative electrodes. Cell life is presently limited by separator failure. Scaleup of iron sulfide electrodes from 5 cm² to 25 cm² in area was carried out successfully. A 100-Wh cell was designed and built with electrodes of 100 cm² size. Preparation of high-purity lithium-resistant ceramic components was inaugurated. A 150-Wh cell is being designed. A new solid lithium--silicon alloy negative electrode was discovered. Lithium release problems with liquid electrodes are eliminated with this solid electrode. The lithium--silicon alloy offers a higher capacity and less voltage loss than the lithium-aluminum alloy, and heat management requirements are alleviated. 13 figures, 5 tables.

672 (EPRI--127-1) DEVELOPMENT PROGRAM FOR SOLID ELECTROLYTE BATTERIES. FINAL REPORT, 1 JANUARY 1973--30 JUNE 1974. (TRW Systems Group, Redondo Beach, Calif. (USA)). Oct 1974. 48p. Dep. NTIS $4.00.

For Electric Power Research Inst., Palo Alto, CA.

SODIUM-SULFUR BATTERIES;ELECTROLYTES; ALUMINIUM OXIDES;OFF-PEAK ENERGY STORAGE;SEALS; ANODES;CATHODES;PERFORMANCE TESTING

673 (EPRI--128-0-0) SODIUM--SULFUR BATTERY DEVELOPMENT. FINAL REPORT, 1 APRIL 1973--30 APRIL 1974. (General Electric Co., Schenectady, N.Y. (USA)). Jul 1974. 49p.

Dep. NTIS $4.00.
For Electric Power Research Inst., Palo Alto, CA.
SODIUM-SULFUR BATTERIES;OFF-PEAK ENERGY STORAGE;ELECTROLYTES;FABRICATION;TESTING; PERFORMANCE;SEALS;ELECTRIC CONDUCTIVITY

674 (EPRI-EM--266) DEVELOPMENT OF SODIUM--SULFUR BATTERIES FOR UTILITY APPLICATION. ANNUAL REPORT. Chatterji, D. (General Electric Co., Schenectady, N.Y. (USA). Research and Development Center). Dec 1976. 248p. Dep. NTIS $8.00.
Work during the past year on the development of a sodium--sulfur battery system for bulk storage of energy is described. Two initial cell/module/system designs are discussed. The cell in these preliminary designs consists of many individual beta-alumina tubes used as the separator between single sodium and sulfur compartments. Heat conduction experiments were made and a complete thermal analysis of the system is given. Progress on construction of a 45-tube cell is given. A comparative cost analysis of the above multitube designs with designs consisting of bundles of cylindrical single-tube cells indicated that the latter approach would probably have a cost advantage. A statistical analysis of the effects of failure or change in performance of individual cells or modules and a study on optimization of the system cost were performed. Improvements in the microstructure, grain boundary resistance, and surface uniformity of the ceramic electrolyte resulted in cells with lower resistance and no sign of ceramic degradation after more than six months of continuous charge and discharge at constant current. Over 300 Ah/cm$^2$ was obtained with no limit evident, and the surface resistance problem was solved. Improvements in the design of the graphite current collector resulted in consistently high cell capacity. The utilization of sulfur achieved increased up to a value of 95%. A few cells using stainless steel containers showed no decrease in either cell capacity or cell resistance up to the present extent of testing (190 cycles for one cell) or to the time of failure due to seal failures. Supporting research included corrosion studies on container materials, sodium motion and defect structure in beta alumina, pressure--temperature stability of $\beta$ and $\beta''$-alumina, and the effects of grain orientation on the electrical properties of beta-alumina. 60 figures, 26 tables.

675 (EPRI-EM--375) DESIGN AND COST STUDY FOR STATE-OF-THE-ART LEAD ACID LOAD LEVELING AND PEAKING BATTERIES. FINAL REPORT. Ferrell, D.T. Jr.; Strohlein, E.M.; Chreitzberg, A.M.; Doe, J.B. (ESB, Inc., Yardley, Pa. (USA). C.F. Norberg Technology Center). Feb 1977. 101p. Dep. NTIS, PC A06/MF A01.
This design and cost study applies state-of-the-art tubular positive lead--acid battery technology to estimate the selling prices for one 2500-cycle, 10-MW, 100-MWh load-leveling battery and two 2000-cycle, 20-MW, peaking batteries delivering 60 and 100 MWh. Accessories for the batteries judged vital to meeting the EPRI performance and life requirements are described and priced. These prices, including transportation and installation, are respectively $62, $65, and $73/kWh for the first battery purchased, but are reduced by salvage-reuse credits to $29, $30, and $33/kWh for the second battery purchased. Amortized in the price is a battery manufacturing plant investment of 14.4 million for a three-shift operation producing 1000 MWh/y. 24 figures, 11 tables.

676 (EPRI-EM--460) DEVELOPMENT OF LITHIUM--METAL SULFIDE BATTERIES FOR LOAD LEVELING. PROGRESS REPORT NO. 3, JULY 1, 1975--SEPTEMBER 30, 1976. McCoy, L.; Adler, E.; Ervin, G.; Hall, J.; Lai, S.; Lee, H.; Raleigh, D.; Sammells, A.; Saunders, R.C. (Atomics International Div., Canoga Park, Calif. (USA)). Jul 1977. Contract W-31-109-ENG-38. 129p. Dep. NTIS, PC A07/MF A01.
Work carried out at the Atomics International Division of Rockwell International for the development of high-temperature lithium--silicon iron sulfide batteries for electric utility off-peak energy storage during the period of July 1, 1975, to September 30, 1976, is described. Research efforts in this reporting period were directed to the development of lithium--silicon negative electrodes, FeS positive electrodes, and ceramic separators stable in contact with lithium metal and lithium--silicon alloys. Compact cells with capacities up to one kWh were built and operated. Positive electrode developments include rigid, corrosion-resistant electrode structures assembled by a proprietary brazing technique for assembly of cells in the initially discharged state. Improvements in the performance of lithium--silicon negative electrodes assembled in the initially discharged condition were achieved by the use of an additive to silicon. Construction and operation of lithium--silicon iron sulfide cells with capacities ranging from approximately 25 Wh to one kWh were carried out. A 150-Wh cell, built and placed in operation prior to this period, completed over 1120 cycles in an operational period exceeding one year. Remarkable stable operation was obtained in the first 5000 hours of operation, and about 65% of the initial capacity was retained after 11,000 hours of operation. Engineering studies indicate that energy densities of about 200 and 150 Wh/kg may be reached with $Li_5Si$--$FeS_2$ and $Li_4Si$--FeS cells, respectively. Cost estimates of $35/kWh were calculated for LiSi--$FeS_2$ cells with capacities of 2.5 kWh at production levels of 1000 MWh or higher. 43 figures, 23 tables.

677 (ERDA--76-136, pp 222-233) LITHIUM/METAL - SULFUR ADVANCED BATTERIES. Ivens, R.O. 1976.
From Highway vehicle systems contractors coordination meeting; Ann Arbor, Michigan, USA (4 May 1976).
Highway vehicle systems contractors coordination meeting. Tenth summary report.
A report is given of design efforts and test results from a research and development program on high-performance batteries suitable for powering electric vehicles and for storing off-peak energy to level the loads on generating equipment in electric utility systems. The main effort consists of developing battery cells containing a lithium--aluminum alloy in the negative electrode and a metal sulfide such as FeS or $FeS_2$ in the positive electrode. The electrolyte is the LiCl--KCl eutectic, which has a melting point of 352°C. For this reason the cells are operated at temperatures between 380 and 450°C. The technical effort in this program is unusually broad in scope, ranging from basic electrochemistry to the design and construction of prototype batteries for each application. Because of the high temperature of operation and the presence of highly reactive materials in the cells, the selection of suitable metals and ceramics for cell components is of particular concern. Extensive compatibility and corrosion studies are

required to assure that these materials will meet cell lifetime and performance requirements.

678 (LA--6632-MS) ELECTROCHEMICAL HEAT ENGINES. Elliott, G.R.B. (Los Alamos Scientific Lab., N.Mex. (USA)). Dec 1976. Contract W-7405-ENG-36. 11p. Dep. NTIS $3.50.
Any nearly reversible electrochemical cell reaction involving a significant entropy change can, in principle, be made the basis of a heat engine. Usual Carnot cycle efficiency limits apply, and the appropriate thermodynamic equations are very similar to those for Ford's sodium heat engine or for usual heat-to-work cycles in physical chemistry textbooks. *Electrochemical heat engines produce* electrochemical rather than mechanical work, and mechanical motion is limited to valve and switching actions as the heat-to-work cycles are performed. Practical devices will presumably use molten or solid electrolytes at high temperatures, and one or more reactions in the cycle will generate a gas at high temperature which can be condensed at a lower temperature with later return of the condensate to the electrochemical cell for further steps of the cycle. Sodium, potassium, and cesium look particularly promising as the working gases for higher-temperature cells (above 600 K), and halogen gases or volatile halides may be useful with lower-temperature heat sources. Carbonates and halides look promising as molten electrolytes, and solid electrolytes may be useful as separators. 3 figures, 3 tables.

679 (N--64-19376, pp 2-5) RCA'S ROLE IN DIRECT ENERGY CONVERSION. Chace, D.W. 1963.
Direct energy conversion.
Solar cells, MHD, batteries, and thermionics. ELECTRIC BATTERIES;SOLAR CELLS;MHD GENERATORS;THERMIONIC CONVERTERS;RESEARCH PROGRAMS

680 (N--65-18935) RESEARCH AND DEVELOPMENT OF A HIGH-CAPACITY NONAQUEOUS SECONDARY BATTERY. FIRST QUARTERLY REPORT. (Mallory (P.R.) and Co., Inc., Burlington, Mass. (USA)). 1965. 57p. (NASA-CR--54319). NTIS $6.00.
P.R. Mallory and Co. Lab. for Physical Science. ELECTRIC BATTERIES;RESEARCH PROGRAMS; LITHIUM;ELECTRODES;ELECTROLYTES;FABRICATION; ELECTROCHEMISTRY;TESTING;WATER

681 (N--65-36781) DEVELOPMENT OF A HIGH-TEMPERATURE BATTERY. FINAL REPORT. Anderson, W.G.; Parker-Jones, H.A.; Place, T.M.; Salisbury, B.G.; Segovia, G. (Aeronutronic, Newport Beach, Calif. (USA)). 15 Oct 1965. 182p. (NASA-CR--54731). NTIS $6.00.
Li--Mg/CuCl with zeolite separator. HIGH TEMPERATURE;LITHIUM ALLOYS;MAGNESIUM ALLOYS; COPPER CHLORIDES;ZEOLITES;LITHIUM-COPPER CHLORIDE BATTERIES;METAL-NONMETAL BATTERIES; BATTERY SEPARATORS;FABRICATION;PORCELAIN; DECOMPOSITION

682 (N--65-36782) RESEARCH AND DEVELOPMENT OF A HIGH-CAPACITY, NONAQUEOUS SECONDARY BATTERY. SECOND QUARTERLY REPORT. (Mallory (P.R.) and Co., Inc., Burlington, Mass. (USA)). 1965. 56p. (NASA-CR--54407). NTIS $6.00.
P.R. Mallory and Co. Lab. for Physical Science. LITHIUM;COPPER;RESEARCH PROGRAMS; ELECTRIC BATTERIES;PURIFICATION;REDUCTION

683 (N--66-15787) RESEARCH AND DEVELOPMENT OF A CAPACITY NONAQUEOUS SECONDARY BATTERY. FOURTH QUARTERLY REPORT, JULY--SEPTEMBER 1965. Hill, K.R.; Rao, M.L.; Selim, R.G. (Mallory (P.R.) and Co., Inc., Burlington, Mass. (USA)). 11 Nov 1965. 91p. (NASA-CR--54874). NTIS $6.00.
ELECTRIC BATTERIES;CATHODES;DEPOSITION; LITHIUM;PURIFICATION;NITRILES;FABRICATION; EFFICIENCY;ELECTROCHEMISTRY;ELECTRODES; ELECTROLYSIS;METALS;CARBONIC ACID ESTERS; SOLUTIONS;SOLVENTS;RESEARCH PROGRAMS

684 (N--68-21038) ELECTROCHEMICAL ENGINEERING. Nanis, L.; Bockris, J.O.; Javet, P. (Pennsylvania Univ., Philadelphia (USA). Inst. for Direct Energy Conversion). Dec 1967. 9p. NTIS.
HYDROGEN FUEL CELLS;OXYGEN;FOAMS;OVERVOLTAGE; TRANSIENTS;ELECTRODES;INSTABILITY;IMPURITIES; CYLINDERS;PRIMARY BATTERIES;ELECTRIC BATTERIES; MATHEMATICAL MODELS;ENGINEERING; ELECTROCHEMISTRY;CHARGE TRANSPORT;RESEARCH PROGRAMS

685 (N--68-27684) TOWARD IMPROVED PRIMARY ELECTROCHEMICAL POWER SYSTEMS. Cohn, E.M. (National Aeronautics and Space Administration, Washington, D.C. (USA)). 1967. 6p. (NASA-TM-X--59054). NTIS $3.00.
FUEL CELLS;ELECTRIC BATTERIES;SILVER-ZINC BATTERIES;HYDRAZINE FUEL CELLS;AIR;ALCOHOL FUEL CELLS;HYDROGEN FUEL CELLS;ELECTROLYTES; CATALYSTS;REVIEWS;USES;STORAGE LIFE;SERVICE LIFE

686 (N--69-13030) STUDY OF MULTIPLE RESERVE ELECTROCHEMICAL POWER SOURCES. FINAL REPORT. Carson, W.N. Jr.; Christopher, H.A. (General Electric Co., Schenectady, N.Y. (USA). Research and Development Center). Aug 1968. 70p. (NASA-CR--97858). NTIS $6.00.
Li/CuS, Li/Se, metal/$O_2$ cells. DESIGN; SPACECRAFT POWER SUPPLIES;METAL-NONMETAL BATTERIES;LITHIUM;COPPER SULFIDES;SELENIUM; METAL-GAS BATTERIES;OXYGEN;ZINC;ALUMINIUM

687 (N--69-16975) DESIGN AND DEVELOPMENT OF A LOW-TEMPERATURE BALLOON BATTERY. PHASE 1 FINAL REPORT, 22 MAY-5 AUG 1968. (Melpar, Inc., Falls Church, Va. (USA)). 5 Aug 1968. Contract NAS5-11557. 38p. (NASA-CR--73711). NTIS.
SOLAR ENERGY CONVERSION;FILMS;PLASTICS; BALLOONS;SOLAR CELL ARRAYS;PERFORMANCE TESTING; MATERIALS TESTING;DESIGN;ELECTRIC BATTERIES

688 (N--69-25396) STUDIES IN FUNDAMENTAL CHEMISTRY OF FUEL CELL REACTIONS. SEMIANNUAL PROGRESS REPORT, 1 JANUARY--30 JUNE 1968. Bockris, J.O. (Pennsylvania Univ., Philadelphia (USA). Electrochemistry Lab.). Jun 1968. Contract NGR-39-010-002. 44p. (NASA-CR--100892; SAPR--12). NTIS $6.00.
Dendritic deposition of zinc from alkaline solution. DENDRITES;DEPOSITION;HYDROXIDES; ANODES;ZINC-MANGANESE BATTERIES;SILVER-ZINC BATTERIES;NICKEL-ZINC BATTERIES;METAL-GAS BATTERIES;ALKALI METALS;AIR;DESIGN;COMPUTER CODES;POTENTIAL ENERGY;IONS;TRAJECTORIES; CRYSTAL LATTICES;ZINC

689 (N--69-25397) STUDIES IN FUNDAMENTAL CHEMISTRY OF FUEL CELL REACTIONS. SEMIANNUAL PROGRESS REPORT, 1 JULY--31 DECEMBER 1968. Bockris, J.O. (Pennsylvania Univ., Philadelphia (USA). Electrochemistry Lab.). Dec 1968. Contract NGR-39-010-002. 19p. (NASA-CR--100893; SAPR--13). NTIS $3.00.

Formation mechanisms of zinc dendrites. METAL-GAS BATTERIES;AIR;RESEARCH PROGRAMS; ELECTRIC BATTERIES;CHEMICAL REACTIONS;RESEARCH PROGRAMS;ELECTROCHEMISTRY;NITROBENZENE; HYDROXYLAMINE;ZINC;DENDRITES;ELECTRIC BATTERIES; SILVER-ZINC BATTERIES;NICKEL-ZINC BATTERIES; ZINC-MANGANESE BATTERIES;ANODES

690 (N--69-36829) ELECTROCHEMICAL CHARACTERIZATION OF NONAQUEOUS SYSTEMS FOR SECONDARY BATTERY APPLICATION. Ludwig, F.A.; Paez, O.A.; Shaw, M. (Whittaker Corp., San Diego, Calif. (USA)). Sep 1969. Contract NAS3-8509. 229p. (NASA-CR--1434). NTIS $6.00.
Testing of electrode--organic electrolyte combinations by cyclic voltammetry. ELECTROLYTES;ORGANIC COMPOUNDS;METAL-METAL BATTERIES;ELECTRODES;COPPER;CADMIUM;SILVER;ZINC; PERFORMANCE TESTING

691 (N--70-11022) BIOSATELLITE FUEL CELL/ BATTERY POWER SYSTEM. Bennett, C.W.; Bruhin, A.C. (General Electric Co., Philadelphia, Pa. (USA)). 1969. Contract NAS2-1900. 23p. (NASA-CR--73376). NTIS $6.00.
SPACECRAFT POWER SUPPLIES;HYDROGEN FUEL CELLS;OXYGEN;SILVER-ZINC BATTERIES;OPTIMIZATION; DESIGN;HYBRID SYSTEMS

692 (N--70-18977) HEAT STERILIZABLE AND IMPACT RESISTANT NI--CD BATTERY DEVELOPMENT. QUARTERLY REPORT, 1 JULY--30 SEPTEMBER 1969. Popat, P.V. (Texas Instruments, Inc., Attleboro, Mass. (USA)). Sep 1969. 175p. (NASA-CR--108170). NTIS, PC A07/MF A01.
ELECTROCHEMISTRY;NICKEL-CADMIUM BATTERIES; HEAT TREATMENTS;POLARIZATION

693 (N--70-25303) STUDIES IN FUNDAMENTAL CHEMISTRY OF FUEL CELL REACTIONS. QUARTERLY REPORT, 1 OCTOBER--31 DECEMBER 1969. Bockris, J.OM. (Pennsylvania Univ., Philadelphia (USA). Electrochemistry Lab.). 31 Dec 1969. Contract NGR-39-010-002. 48p. (NASA-CR--109513; QR--4). NTIS $3.00.
Mg/C, discharge characteristics; Fe/O. RHODIZONIC ACID;GRAPHITE;CARBON BLACK;MAGNESIUM; METAL-NONMETAL BATTERIES;PERFORMANCE;EFFICIENCY; ANODES;IRON;OXYGEN;METAL-GAS BATTERIES; POTASSIUM HYDROXIDES;POTASSIUM CHLORIDES

694 (N--70-29061) NICKEL--CADMIUM, SILVER--CADMIUM, AND SILVER--ZINC BATTERIES. Seibert, G. (European Space Research and Technology Centre, Noordwijk (Netherlands)). Sep 1969. 26p. (ESRO-TN--81). NTIS, PC A02/MF A01.
SILVER-CADMIUM BATTERIES;NICKEL-CADMIUM BATTERIES;SILVER-ZINC BATTERIES;SPACECRAFT POWER SUPPLIES;MEETINGS;ELECTRIC POTENTIAL

695 (N--70-34014) HEAT-STERILIZABLE AND IMPACT-RESISTANT NI--CD BATTERY DEVELOPMENT. VOLUME 1. ELECTROCHEMISTRY OF HEAT-STERILIZABLE SEALED CELLS. FINAL REPORT, 1 JULY 1967--31 DECEMBER 1969. Crawford, R.L.; Popat, P.V. (Jet Propulsion Lab., Pasadena, Calif. (USA)). 31 Dec 1969. 22p. (NASA-CR--109854). NTIS, PC A02/MF A01.
NICKEL-CADMIUM BATTERIES;ELECTROCHEMISTRY; RESEARCH PROGRAMS;DESIGN;FABRICATION;TESTING; TEMPERATURE EFFECTS;SEALS

696 (N--71-10258) SPACECRAFT POWER: GUIDANCE AND CONTROL DIVISION. (Jet Propulsion Lab., Pasadena, Calif. (USA)). 31 Aug 1970. 60p. NTIS.
Neutron yield from (d,n) reactions; fuel cells with liquid amalgam electrodes. SPACECRAFT POWER SUPPLIES;RESEARCH PROGRAMS; ANALYTICAL SOLUTION;ALPHA REACTIONS;NEUTRONS; NUCLEAR REACTION YIELD;IMPURITIES;DC TO DC CONVERTERS;MICROELECTRONIC CIRCUITS;DESIGN;FUEL CELLS;MERCURY ALLOYS;ELECTRODES;NICKEL-CADMIUM BATTERIES;RESEARCH PROGRAMS

697 (N--74-14792) BATTERIES. REPORT BIBLIOGRAPHY, JAN 1967--APR 1973. (Defense Documentation Center, Alexandria, Va. (USA)). Oct 1973. 356p. (AD--768500; DDC-TAS--73-59). NTIS.
BIBLIOGRAPHIES;NICKEL-CADMIUM BATTERIES; ELECTRIC BATTERIES;DESIGN;TESTING;PLANNING; PERFORMANCE

698 (N--74-17791) DEVELOPMENT AND FABRICATION OF SEALED SILVER--ZINC CELLS, PHASE 1. FINAL REPORT. Blake, I.C.; Donnell, C.P., III. (Yardney Electric Corp., Pawcatuck, Conn. (USA)). Dec 1973. 56p. (NASA-CR--134591). NTIS $6.00.
SILVER-ZINC BATTERIES;FABRICATION;BATTERY SEPARATORS;TESTING;PERFORMANCE TESTING;CERAMICS

699 (N--74-17798) CONSTRUCTION OF 850 AND 4,000 AMPERE-HOUR SILVER--ZINC CELLS USING INORGANIC SEPARATOR. FINAL REPORT, JUL 1972--OCT 1973. Grun, C. (Molecular Energy Corp., Murray Hill, N.J. (USA)). Dec 1973. Contract N00024-73-C-5043. 32p. (AD--771397; MEC--10-73). NTIS.
SILVER-ZINC BATTERIES;FABRICATION;TESTING; SUBMARINES

700 (N--74-17805) SECONDARY ZINC--OXYGEN BATTERIES. FINAL REPORT, JUN 1972--JUN 1973. Klein, M. (Energy Research Corp., Bethel, Conn. (USA)). Nov 1973. Contract DAAB-07-72-C-0272. 46p. (AD--771961; ECOM--0272-F-72). NTIS.
ZINC-AIR BATTERIES;BATTERY SEPARATORS; ELECTRODES;DESIGN;FABRICATION;TESTING

701 (N--74-20708) INVESTIGATION OF HIGH TEMPERATURE BATTERY SYSTEMS. FINAL TECHNICAL REPORT, 1 JUL 1972--31 OCT 1973. Seo, E.T.; Sayano, R.R.; Carroll, D.F.; McIanahan, M.L.; Silverman, H.P. (TRW Systems Group, Redondo Beach, Calif. (USA)). Jan 1974. Contract DAAB-07-72-C-0312. 46p. (AD--774308; TRW--23323-6015-RU-00; ECOM--0312-F). NTIS.
SODIUM-SULFUR BATTERIES;FABRICATION;TESTING; HIGH TEMPERATURE;SEALS;CERAMICS;METALS

702 (N--74-26501) STUDY OF PROCESS VARIABLES ASSOCIATED WITH MANUFACTURING HERMETICALLY-SEALED NICKEL--CADMIUM CELLS. FINAL REPORT. Miller, L. (Eagle-Picher Industries, Inc., Joplin, Mo. (USA). Couples Dept.). Apr 1974. Contract NAS5-21159. 226p. (NASA-CR--139025). NTIS $14.50.
NICKEL-CADMIUM BATTERIES;FABRICATION;SPACE VEHICLES;SINTERING;SINTERED MATERIALS; IMPREGNATION

703 (N--74-34545) STUDY OF OXYGEN GAS PRODUCTION PHENOMENON DURING STAND AND DISCHARGE IN SILVER--ZINC BATTERIES. FINAL REPORT. (Eagle-Picher Industries, Inc., Joplin, Mo. (USA). Electronics Div.). 8 Oct 1975. Contract NAS9-12032. 75p. (NASA-CR--140306). NTIS $6.75.
SILVER-ZINC BATTERIES;OXYGEN;GASES; PERFORMANCE;STORAGE;FABRICATION;POTASSIUM

HYDROXIDES;PLATES;RECOMMENDATIONS;OPTIMIZATION

704 (N--75-14266) 100 AMPERE-HOUR NICKEL--CADMIUM BATTERY DEVELOPMENT PROGRAM. VOLUME 1. FINAL REPORT. Gaston, S. (Grumman Aerospace Corp., Bethpage, N.Y. (USA)). Mar 1974. Contract NAS9-11074. 384p. (NASA-CR--140380). NTIS $10.25.
NICKEL-CADMIUM BATTERIES;SPACECRAFT POWER SUPPLIES;SEALS;PERFORMANCE;BATTERY CHARGING

705 (N--75-14267) 100 AMPERE-HOUR NICKEL--CADMIUM BATTERY DEVELOPMENT PROGRAM. VOLUME 2. Gaston, S. (Grumman Aerospace Corp., Bethpage, N.Y. (USA)). Mar 1974. Contract NAS9-11074. 361p. (NASA-CR--140381). NTIS $10.00.
NICKEL-CADMIUM BATTERIES;SPACECRAFT POWER SUPPLIES;SEALS;PERFORMANCE;BATTERY CHARGING

706 (N--75-16974) DESIGN AND TEST OF A 100 AMPERE-HOUR NICKEL CADMIUM BATTERY MODULE. Gaston, S.; Wertheim, M.; Burgess, F.S.; Lehrfeld, D.; Winegard, A. (Grumman Aerospace Corp., Bethpage, N.Y. (USA)). Mar 1973. Contract NAS9-11074. 192p. (NASA-CR--141600). NTIS $7.00.
NICKEL-CADMIUM BATTERIES;DESIGN;TESTING; FEASIBILITY STUDIES;FABRICATION;SPACE VEHICLES; PLANNING

707 (N--75-21792) NICKEL--CADMIUM CELLS. FINAL REPORT, 30 MARCH 1972--30 MAY 1973. Rubin, E.J.; Turchan, M.J. (Tyco Labs., Inc., Waltham, Mass. (USA)). Aug 1974. NAS5-23102. 116p. (NASA-CR--143715; C--227). NTIS $5.25.
NICKEL-CADMIUM BATTERIES;DESIGN;FABRICATION; PLATES;ELECTRODES

708 (N--75-30647) FUNDAMENTAL STUDIES CONNECTED WITH ELECTRO-CHEMICAL ENERGY STORAGE. FINAL REPORT. Buck, E.; Sen, R. (Pennsylvania Univ., Philadelphia (USA). Dept. of Chemistry). 1974. Contract NGL-39-010-002. 194p. (NASA-CR--143378). NTIS $7.00.
Papers are presented which deal with electrochemical research activities. Emphasis is placed on electrochemical energy storage devices. Topics discussed include adsorption of dendrite inhibitors on zinc, proton discharge process, electron and protron transfer, quantum mechanical formulation of electron transfer rates, and theory of electrochemical kinetics in terms of two models of activation--thermal and electrostatic. (GRA)

709 (N--75-33496) DESIGN AND FABRICATION OF SILVER--HYDROGEN CELLS. Klein, M.G. (Energy Research Corp., Bethel, Conn. (USA)). 1975. Contract NAS3-18543. 71p. (NASA-CR--134878). NTIS $4.50.
The design and fabrication of silver--hydrogen secondary cells capable of delivering higher energy densities than comparable nickel--cadmium and nickel--hydrogen cells and relatively high cycle life is presented. An experimental task utilizing single electrode pairs for the optimization of the individual electrode components, the preparation of a design for light-weight 20-Ah cells, and the fabrication of four 20-Ah cells in heavy wall test housing containing electrode stacks of the lightweight design are described. The design approach is based on the use of a single cylindrical self-contained cell with a stacked disc sequence of electrodes. The electrode stack design is based on the use of NASA-Astropower Separator Material, PPF fuel cell anodes, an intercell electrolyte reservoir concept, and sintered silver electrodes. Results of performance tests are given. (auth)

710 (N--76-13598) NICKEL-CADMIUM CELLS. FINAL REPORT, 30 MAR. 1972--30 MAY 1973. Rubin, E.J.; Turchan, M.J. (Tyco Labs., Inc., Waltham, Mass. (USA)). Aug 1974. Contract NAS5-23102. 116p. (NASA-CR--145809; C--227). NTIS $3.50.
A program to develop a high energy density nickel cadmium cell of aerospace quality is described. Manufacturing techniques which produce highly uniform and controlled starting materials were utilized in addition to improvements in the overall design. Parameters controlling the production of plaque and both positive and negative plate were studied. Quantities of these materials were produced and prototype cells were assembled to test the proposed design. (Author) (GRA)

711 (N--76-26702) EXPLORATORY STUDY OF HYDROGEN/SILVER OXIDE BATTERIES FOR SPACE APPLICATION. FINAL REPORT. Jonville, P.; Breda, F. (Battelle Memorial Inst., Geneva (Switzerland)). Oct 1975. Contract ESTEC-2296/74-HP. 402p. (ESA-CR(P)--781). NTIS $11.00.
To determine the applicability of the hydrogen/silver oxide system as electrical energy storage device for satellites and to investigate the problems involved when associating a metal oxide electrode to a gaseous diffusion electrode, the silver oxide/hydrogen couple performance was investigated. The operational mode of each constituent (hydrogen electrode, silver electrode) of the battery was studied, their characteristics were evidenced and compared, and their compatibility was analyzed. Performances and limitations of the hydrogen/silver oxide battery were assessed and compared to those of the $H^2$/NiOOH. The electrolyte, the separator, the container and its configuration, seals, and some specific problems such as thermal transfer are also reviewed. (GRA)

712 (N--76-28642) DEVELOPMENT AND FABRICATION OF LARGE VENTED NICKEL--ZINC CELLS. FINAL REPORT. Donnel, C.P.I. (Yardney Electric Corp., Pawcatuck, Conn. (USA)). Dec 1975. Contract NAS3-18515. 60p. (NASA-CR--134967). NTIS, PC A04/MF A01.
A preliminary cell design for a 300-Ah vented nickel--zinc cell was established based on volume requirements and cell component materials selected by NASA Lewis Research Center. A 100-Ah cell configuration was derived from the 300-Ah cell design utilizing the same size electrodes, separators, and cell terminal hardware. The first cells fabricated were four groups of three cells each in the 100-Ah size. These 100-Ah experimental nickel--zinc cells had as common components the nickel positive electrodes (GFM), flexible inorganic separator (GFM) bags on the negative electrodes, pressed powder zinc oxide electrodes, and cell containers with hardware. The variations introduced were four differing electrolyte absorber (interseparator) systems used to encase the nickel positive electrodes of each cell group. The four groups of 100-Ah experimental vented nickel--zinc cells were tested to determine, based on cell performance, the best two interseparator systems. Using the two interseparator systems, two groups of experimental 300-AH cells were fabricated. Each group of three cells differed only in the interseparator material used. The six cells

ELECTRICAL GENERATOR AND ELECTROLYSIS CELL FOR A WIND ENERGY CONVERSION SYSTEM. FINAL REPORT, 1 JUL 1973--1 JUL 1975. Hughes, W.L.; Allison, H.J.; Ramakumar, R.G. (Oklahoma State Univ., Stillwater (USA). School of Electrical Engineering). 10 Jul 1975. 280p. NTIS $8.75.

See also PB--239272..

This final report describes progress made at the Oklahoma State University on wind energy utilization. The specific objectives of this research program were: (1) to develop and build a working field modulated generator system in the 10/20 kW range suitable for use in a wind energy system to deliver standard 110/220 V single-phase 60 Hz power over a 2 to 1 range of speeds; (2) to develop and build a working high-pressure moderate-temperature electrolysis system in the 2-3kW input range in the available high pressure test facility; and (3) to design and construct a wind generator test station at the Stillwater airport using existing field modulated generators and bicycle-wheel type aeroturbines developed by the American Wind Turbine Company. Final reports are presented covering performance details on the products of each of the three objectives. A large Appendix reproduces 13 papers generated during the two year contract period. (GRA)

728 (PB--244390) DEVELOPMENT OF LITHIUM-METAL SULFIDE BATTERIES FOR LOAD LEVELING. INTERIM REPORT. Hall, J.; Lai, S.; McCoy, L.; Saunders, R. (Rockwell International Corp., Canoga Park, Calif. (USA)). Jun 1975. 47p. NTIS $3.75.

This project concerns the development of a lithium-iron sulfide battery for electric utility energy storage that uses a molten KCl-LiCl electrolyte and is operated at about 400C. This report describes the work performed on iron sulfide positive electrodes and the status of associated elements of the project concerned with lithium negative electrodes, ceramic components and cell design. Investigations of iron sulfide active materials, current conductive matrices and electrode housings have been made with the objective of developing low cost, long-lived iron sulfide electrodes. The iron sulfide electrodes have been tested in cells using liquid lithium negative electrodes. Scaleup of iron sulfide electrodes from 5 sq cm to 25 sq cm in area has been carried out successfully. A program for the preparation of high purity lithium-resistant ceramic components has been initiated. A new solid lithium-silicon alloy negative electrode has been discovered. The lithium-silicon alloy offers a higher capacity and less voltage loss than the lithium-aluminum alloy. (GRA)

729 (PB--248326) DEVELOPMENT PROGRAM FOR SOLID ELECTROLYTE BATTERIES. INTERIM REPORT. Silverman, H.P. (TRW Systems Group, Redondo Beach, Calif. (USA)). Dec 1975. 88p. NTIS $5.00.

This report provides an overview of the development effort for the previous year, including a discussion of the approach to the problem, an elucidation of the more specific objectives, and an organizational introduction to the work. The long-term requirements of the battery system directed towards the engineering and production aspects of large battery systems are stressed. Specific technologies receive appropriate attention, but undue emphasis is not placed in individual technologies. Emphasis is placed on simple cell geometries that are consistent with requirements of load-leveling battery systems and on solid electrolytes that possess the appropriate balance of conductivity, strength, cost, and lifetime. (GRA)

730 (PB--251490) NEAR-TERM ENERGY STORAGE TECHNOLOGIES: THE LEAD--ACID BATTERY. A COMPILATION OF WORKSHOP PAPERS PRESENTED ON NOVEMBER 18--19, 1975. (Electric Power Research Inst., Palo Alto, Calif. (USA)). Mar 1976. Contract W-31-109-ENG-38. 233p. (EPRI-SR--33). Dep. NTIS $8.00.

In 1975, ANL/ERDA, and EPRI, and International Lead-Zinc Research Organization, New York, NY initiated cost and design studies of state-of-the-art lead--acid batteries for utility application to determine the viability of today's lead--acid batteries for load-leveling application. Other leading battery firms were selected to develop battery designs (based on state-of-the-art technology) capable of meeting the technical requirements for load-leveling. The cost of manufacturing and the ultimate price for these batteries were determined assuming high volume production (1000 MWh/year). In addition, ANL/ERDA initiated at Bechtel Corporation an engineering study of a 20 MW/200 MWh Lead--Acid Battery Energy Storage Demonstration Plant. This report contains the papers from the workshop held to present and evaluate the results of these efforts, to provide an information base for utility planners in this area, and to obtain the outlook and prospects for these batteries in individual utility systems. Results of a questionnaire given to utility representatives on the prospects for lead--acid batteries are also presented. Separate abstracts were prepared for each of the 12 papers given at the workshop for inclusion in ERDA Energy Research Abstracts (ERA); only this leading abstract is included in EAPA. (RWR)

731 (PB--251490, pp 3-8) NEAR-TERM UTILITY ENERGY-STORAGE TECHNOLOGIES. I. WORKSHOP ON THE LEAD--ACID BATTERY: WORKSHOP OBJECTIVES. Birk, J.R. (Electric Power Research Inst., Palo Alto, CA). Mar 1976.

Near-term energy storage technologies: workshop on lead--acid batteries, Palo Alto, California, November 18--19, 1975.

The major purposes of the workshop were to provide an information base regarding lead--acid batteries to utility planners and to obtain the outlook for these batteries in individual utility systems. Advantages of batteries over other types of energy storage are listed. The importance of making the correct decision on whether to spend $40,000,000 for demonstration of the lead--acid battery is pointed out. 2 tables (RWR)

732 (PB--251490, pp 91-110) NEW LEAD--ACID BATTERY DESIGN PROPOSED FOR UTILITY PEAKING AND LOAD LEVELING APPLICATIONS. Read, E. (C and D Batteries Division, Plymouth Meeting, PA). Mar 1976.

Near-term energy storage technologies: workshop on lead--acid batteries, Palo Alto, California, November 18--19, 1975.

A design approach for a load-leveling or peaking battery is described. The total cost of furnishing and delivering to the user a typically rated battery is examined. Application and usage considerations are presented, as well as advantages over other forms of bulk energy storage for utilities. 5 figures, 3 tables (RWR)

733 (PB--251490, pp 111-137) STATE-OF-THE-ART DESIGN STUDY OF A LEAD--ACID LOAD LEVELING BATTERY: THE ESB CONCEPT. Ferrell, D.T. Jr. (ESB Inc., Yardley, PA). Mar 1976.

Near-term energy storage technologies: workshop on lead--acid batteries, Palo Alto, California, November 18--19, 1975.

The analysis of tubular vs pasted positive electrodes, the selected design, and a preliminary look at costs and performance are presented. 8 figures, 5 tables (RWR)

734 (PB--251490, pp 138-158) LEAD--ACID BATTERY LOAD LEVELING CONFIGURATION: GOULD PRESENTATION. Hellmann, E. Mar 1976.

Near-term energy storage technologies: workshop on lead--acid batteries, Palo Alto, California, November 18--19, 1975.

Work by Gould on a unique battery configuration for load leveling is described. Emphasis was on the mature market application. Major guidelines and desirable characteristics of such a battery are set forth. Four basic cell configurations were examined. Cost estimates and characteristics of a modularized 20-MW, 200-MWh dc load-leveling system are given. 6 figures, 3 tables (RWR)

735 (PB--254596) INDUSTRIAL ACCIDENTS AND HYGIENE SERIES, NO. 6. LEAD POISONING IN THE MANUFACTURE OF STORAGE BATTERIES. FINAL REPORT. Hamilton, A. (Bureau of Labor Statistics, Washington, D.C. (USA)). 15 Dec 1914. 40p. (BLS-Bull--165). NTIS $4.00.

Based on visits to five large factories, the report is a collection of information dealing with processes in manufacture of storage batteries, hygienic conditions of storage battery plants, extent of sanitary facilities provided for employees, and medical care provided employees. It also discusses wages, duration of employment, and nationality of employees. The bulletin deals with the danger of the different processes, the type of poisoning, number of cases of poisoning in the five factories, and sources of information concerning lead poisoning. (GRA)

736 (PB--260719) DEVELOPMENT PROGRAM FOR SOLID ELECTROLYTE BATTERIES. FINAL REPORT. Birk, J.R. (TRW Defense and Space Systems Group, Redondo Beach, Calif. (USA)). Sep 1976. 104p. NTIS, PC A06/MF A01.

See also report dated Dec 1975, PB--248326.

This report presents results obtained in TRW's sodium-sulfur battery program during the period from 1 July 1975 to its conclusion on 30 April 1976. The long-range objective of the program was the development and commercialization of sodium-sulfur battery for electric utility energy storage. The study demonstrated that the major challenges of developing the sodium-sulfur battery into a commercially viable energy-storage system are (1) development of corrosion resistant sulfur-electrode containers; (2) design and development of a less highly stressed seal; (3) fabrication of long-life electrolytes; and (4) design of cells capable of full utilization of the active positive-electrode material (sulfur).

737 (PB--262016) ENGINEERING DESIGN AND COST ANALYSIS OF CHLORINE STORAGE CONCEPTS FOR A ZINC--CHLORINE LOAD-LEVELING BATTERY. FINAL REPORT. Battey, R.F. (Bechtel Corp., San Francisco, Calif. (USA)). Nov 1976. 118p. NTIS, PC A06/MF A01.

This project evaluated and compared alternative chlorine storage approaches in terms of the key technical, safety, economic, and environmental aspects. The study has demonstrated for an ambient pressure zinc--chloride battery that the chlorine hydrate approach is a simpler and less expensive storage system than liquid chlorine. Absorption of chlorine in carbon tetrachloride was ruled out because adequate energy efficiencies could not be obtained for the battery system using this chlorine-storage concept. An analysis of the chlorine storage systems studied indicates that safety hazards are moderate and that no extraordinary hazards exist. In addition, the various chlorine storage approaches studied appear to be in compliance with existing environmental regulations.

738 (PB--263682) RANN UTILIZATION EXPERIENCE (CASE STUDIES 22 THROUGH 31). FINAL REPORT. Burger, R.M.; Massoglia, M.F. (Research Triangle Inst., Durham, N.C. (USA)). Aug 1976. Contract NSF-C76-17165. 288p. NTIS PC A13/MF A01.

This report contains case studies of the utilization of research results of ten Research Applied to National Needs (RANN) projects that were selected as representative of well utilized efforts. The selection was based on data obtained in a sample survey designed to determine the extent of utilization of RANN research projects that were initiated in February 1972 and February 1973. These case studies followed twenty-one that were previously prepared and distributed, and will be followed by additional utilization case studies. Findings and analysis are confined to the individual cases. Subject areas include: (1) Development of x-ray fluorescence analysis and application to atmospheric aerosols; (2) Dredge spoil distribution and estuarine effects; (3) Laboratory cloud simulation to support weather modification research and field programs; (4) Feasibility study: coordination of data collection activities on the nation's building inventory; (5) Biological conversion of organic refuse to methane; (6) Fire and smoke spread in corridors; (7) Computer abuses; (8) Problems and research priorities in the Rocky Mountain region; (9) Development of a plan to maximize the learning from destructive earthquakes; and (10) Research and development of lithium/sulfur secondary batteries.

739 (PB--266261) PRESCRIPTION FOR BATTERY WORKERS. (National Inst. for Occupational Safety and Health, Cincinnati, Ohio (USA)). Mar 1976. 32p. (NIOSH--76/153; DHEW/PUB/NIOSH--76/153). NTIS PC A03/MF A01.

The practical safety booklet for battery workers describes the hazards that may exist in lead acid storage battery plants and the illness or injuries that may be caused by the hazards, and it points out what to do if a hazard is recognized. Topics include health hazards from lead dust and fumes, sulfuric acid, heat, noise, unsanitary conditions, fire hazards and prevention, personal protective equipment and first aid. It summarizes the hazards and controls, and points out the responsibilities of the worker and the employer.

740 (PD--18289) ELECTRICAL POWER SOURCES DIVISION. QUARTERLY PROGRESS NOTES, 1 OCTOBER 1974--31 DECEMBER 1974. (Defence Research Establishment, Ottawa, Ontario (Canada)). Mar 1975. 65p. (ADB--003168). Dep. NTIS (US Sales Only) $6.25.

Lead-acid and nickel-cadmium batteries; fuel cells. ELECTRIC POWER;ELECTRIC BATTERIES; RESEARCH PROGRAMS;POWER TRANSMISSION; COMMUNICATIONS;CANADA;FUEL CELLS;LEAD-ACID BATTERIES;NICKEL-CADMIUM BATTERIES;WIND POWER

741 (RN-NC--0018) AEROLYTE BATTERY PROGRAM. SUMMARY REPORT, DECEMBER 1967--MAY 1968. Moss, V.; Nole, D.A. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). [nd]. 80p. Dep. NTIS $7.00.
LITHIUM-SULFUR BATTERIES;RESEARCH PROGRAMS; PERFORMANCE TESTING;COMPARATIVE EVALUATIONS

742 (SAE-TP--720040) WATER-ACTIVATED LEAD-ACID DRY-CHARGED BATTERY. Badger, J.P. (Prestolite Co., Toledo, Ohio (USA)). 1972. 15p.
Polyethylene container, 93 percent of $H_2SO_4$ immobilized in phenolic foam block. LEAD-ACID BATTERIES;CONTAINERS;POLYETHYLENES;AUTOMOBILES; ELECTROLYTES;SULFURIC ACID;FOAMS;PERFORMANCE; DESIGN

743 (SAND--74-0007) PELLET-TYPE THERMAL BATTERY. Bush, D.M. (Sandia Labs., Albuquerque, N.Mex. (USA)). Jul 1974. Contract AT(29-1)-789. 21p. Dep. NTIS $4.25.
Fe--Ca, with $CaCrO_4$ depolarizer and LiCl--KCl electrolyte. METAL-METAL BATTERIES; FABRICATION;TESTING;IRON;CALCIUM;CALCIUM COMPOUNDS;CHROMATES;LITHIUM CHLORIDES;POTASSIUM CHLORIDES

744 (SAND--74-0041) CHARACTERISTICS AND DEVELOPMENT OF THE TC-765 THERMAL BATTERY. Weaver, C.O. (Sandia Labs., Albuquerque, N.Mex. (USA)). Sep 1974. Contract AT(29-1)-789. 21p. Dep. NTIS $4.25.
Ca/LiCl--KCl/$CaCrO_4$--Fe. METAL-METAL BATTERIES;DESIGN;PLANNING;PERFORMANCE

745 (SLA--73-0412A) PRELIMINARY STUDY INTO THE FEASIBILITY OF A SIXTY-MINUTE THERMAL BATTERY. Bush, D.M.; Baldwin, A.R. (Sandia Labs., Albuquerque, N.Mex. (USA)). Jul 1974. Contract AT(29-1)-789. 14p. Dep. NTIS $4.00.
Fe--Ca with depolarizer--electrolyte--binder pellets. METAL-METAL BATTERIES;PERFORMANCE TESTING; IRON;CALCIUM

746 (SLA--73-5888) SIXTY-MINUTE THERMAL BATTERY: A FEASIBILITY STUDY. Bush, D.; Baldwin, A. (Sandia Labs., Albuquerque, N.Mex. (USA)). 1974. 28p. (CONF-740908--1). Dep. NTIS $4.50.
From 9. international power sources symposium; Brighton, UK (17 Sep 1974).
Ca/LiCl--KCl, $CaCrO_4$/Fe. METAL-METAL BATTERIES;DESIGN;PERFORMANCE TESTING;IRON; CALCIUM;LITHIUM CHLORIDES;POTASSIUM CHLORIDES; CALCIUM COMPOUNDS;CHROMATES

747 (SLA--74-5363) DEVELOPMENT AND PERFORMANCE OF A MINIATURE, HIGH-VOLTAGE THERMAL BATTERY. Clark, R.P.; Forsman, E.V. (Sandia Labs., Albuquerque, N.Mex. (USA)). [nd]. 6p. (CONF-740805--5). Dep. NTIS $4.00.
From 9. Intersociety Energy Conversion Engineering Conference; San Francisco, California, USA (26 Aug 1974).
Ca/LiCl--KCl/$CaCrO_4$-$K_2CrO_4$ (Fe). METAL-METAL BATTERIES;DESIGN;PERFORMANCE;CALCIUM;IRON; LITHIUM CHLORIDES;POTASSIUM CHLORIDES;CALCIUM COMPOUNDS;POTASSIUM COMPOUNDS;CHROMATES

748 (SLA--74-5381) REVIEW OF THERMAL BATTERY TECHNOLOGY. Van Domelen, B.H.; Wehrle, R.D. (Sandia Labs., Albuquerque, N.Mex. (USA)). 1974. 6p. (CONF-740805--4). Dep. NTIS $4.00.
From 9. Intersociety Energy Conversion Engineering Conference; San Francisco, California, USA (26 Aug 1974).
Ca/LiCl--KCl/$CaCrO_4$ electrochemical system. METAL-METAL BATTERIES;REVIEWS;DESIGN; PERFORMANCE;CALCIUM;LITHIUM CHLORIDES;POTASSIUM CHLORIDES;CALCIUM COMPOUNDS;CHROMATES;IRON

749 (TID--26731) DEVELOPMENT OF HIGH-ENERGY BATTERIES FOR ELECTRIC VEHICLES. PROGRESS REPORT FOR THE PERIOD JULY 1970--JUNE 1971. Cairns, E.J.; Steunenberg, R.K.; Ackerman, J.P.; Feay, B.A.; Gruen, D.M.; Kyle, M.L.; Latimer, T.W.; Mundy, J.N.; Rubischko, R.; Shimoake, H.; Walker, D.E.; Zielen, A.J.; Tevebaugh, A.D. (Argonne National Lab., Ill. (USA)). Jul 1971. 95p. Dep. NTIS $7.75.
ANL. RESEARCH PROGRAMS;ANL;ELECTRIC-POWERED VEHICLES;LITHIUM-SULFUR BATTERIES;PERFORMANCE; ELECTROLYTES;CORROSION;DESIGN

750 (TID--26751) GOVERNMENT-WIDE REPORT TO OFFICE ON MANAGEMENT AND BUDGET ON ENERGY STORAGE R AND D PROGRAM STRATEGIES AND IMPLEMENTATION PLANS. (USAEC Division of Applied Technology, Washington, D.C.). 1 Jun 1974. 91p. Dep. NTIS $7.75.
ENERGY STORAGE;RESEARCH PROGRAMS;FUELS; STORAGE;PUBLIC UTILITIES;POWER PLANTS;FUEL CONSUMPTION;PETROLEUM;ELECTRIC BATTERIES; HYDROGEN;FLYWHEELS;MANAGEMENT;BUDGETS; GOVERNMENT POLICIES;ELECTRIC POWER;POWER TRANSMISSION;HYDROELECTRIC POWER

751 (TID--26756) ELECTRIC POWER SYSTEMS: C-3 ENERGY STORAGE, TRANSMISSION AND DISTRIBUTION, ELECTRIC POWER APPARATUS AND SYSTEMS. (USAEC, Washington, D.C.). 11 Nov 1974. 66p. Dep. NTIS $6.50.
PLANNING;MANAGEMENT;RESEARCH PROGRAMS;ENERGY STORAGE;ELECTRIC BATTERIES;HYDROGEN PRODUCTION; MAGNET COILS;FLYWHEELS;POWER TRANSMISSION;POWER TRANSMISSION LINES;HVDC SYSTEMS;EHV AC SYSTEMS; SUPERCONDUCTING CABLES;UNDERGROUND POWER TRANSMISSION

752 (TID--27055) FORD/ERDA SODIUM--SULFUR BATTERY DEVELOPMENT, PHASE I. FINAL REPORT, JUNE 15, 1975--MARCH 31, 1976. Weiner, S.A. (Ford Motor Co., Dearborn, Mich. (USA)). Jul 1976. Contract E(11-1)-2566. 37p. Dep. NTIS $4.00.
The pre-pilot facility for the batch production of β''-alumina tubing was designed and remodeled. Critical items of capital equipment were specified and placed on order. Work began on the construction of the pre-pilot spray dryer and the batch and continuous sintering furnaces. Two cells incorporating high-power-density electrode design and stainless steel containers for sodium and sulfur were designed, constructed, and tested. The first cell delivered an average of 286 W/kg during one discharge cycle at 750 mA/cm². The energy density was 44 Wh/kg at this high current density, whereas at 50 mA/cm² over 80 Wh/kg could be reached. The cell became non-faradaic after 45 days because of ceramic failure. The second cell was put on test only recently. A cell with separate compartments for charging and discharging and with electrodes optimized for either task was tested successfully. Efforts to develop corrosion-resistant sulfur container materials were initiated. Static sodium tetrasulfide corrosion tests were conducted for 30 to 60 days at 400°C on substrates of pure chromium and iron, nickel, cobalt, aluminum, titanium, niobium, tantalum, zirconium, and molybdenum base

alloys. These substrates were tested with and without various surface treatments and protective coatings. The results showed that aluminum, molybdenum, ferritic stainless steels and Inconels show varying degrees of promise. The first cell tested under this program was thoroughly examined after failure. The coating of graphite-filled polyphenylene resin applied to the AISI 446 stainless steel container had not stood up satisfactorily, perhaps owing to overheating. There were no signs of degradation of any of the seals. 21 figures.

753 (TID--27211) DEVELOPMENT OF AN IRON--AIR BATTERY SYSTEM FOR ELECTRIC VEHICLES. PROGRESS REPORT, AUGUST 1, 1976--AUGUST 31, 1976. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA)). Sep 1976. Contract E(11-1)-2949. 9p. Dep. NTIS $3.50.

Work during the last month on the development of iron--air cells investigated several aspects of the air electrode, and iron electrode. A variety of air electrodes of varying composition and fabrication procedures were tested. One particular air electrode with about 7 percent of the standard silver content (.012 grams/cm$^2$) showed stable and acceptable performance for 50 duty cycles. Other electrodes fabricated by alternate methods and techniques showed equivalent performance as compared to previous hand-pasted air electrodes. Tests with iron electrodes in various electrolytes are underway, as well as preliminary experiments to determine the auxiliary systems requirements for the air and iron electrodes. A prototype size 400 cm$^2$ iron--air cell was built and tested. At a current density of 50 mA/cm$^2$ the cell delivered approximately 28 mW/cm$^2$ during its first cycle. It had a capacity of about 90 Ah to .5 volts on the cell. The performance of the cell deteriorated upon further testing, and the test was terminated due to a severe leak in the cell. 1 table.

754 (UCID--16751) LITHIUM--WATER--AIR BATTERY: A NEW CONCEPT FOR AUTOMOTIVE PROPULSION. Behrin, E.; Borg, I.Y.; Cooper, J.F.; O'Connell, L.G.; Rubin, B.; Wiesner, H.J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 9 Apr 1975. Contract W-7405-Eng-48. 66p. Dep. NTIS $6.50.

Modified lithium--water battery, mechanically rechargeable. LITHIUM;WATER;AIR; METAL-GAS BATTERIES;METAL-NONMETAL BATTERIES; ELECTRIC-POWERED VEHICLES;AUTOMOBILES;ECONOMICS; DESIGN;ELECTROCHEMISTRY;PERFORMANCE;CARBON DIOXIDE;BATTERY CHARGING;COMPARATIVE EVALUATIONS;PRIMARY-SECONDARY HYBRID BATTERIES

755 (UCID--17425) SUMMARY OF THE LITHIUM--AIR BATTERY RESEARCH PROGRAM. Cooper, J.F. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 17 Mar 1977. Contract W-7405-ENG-48. 9p. Dep. NTIS, PC A02/MF A01.

The status of a program to determine the feasibility of a lithium--air battery (or an analog) as an automotive power source is summarized. Anticipated performance of characteristics (including efficiency and voltage) of the battery and the lithium recycling process are described. A calcium/aqueous-electrolyte combination was discovered which shows electrode behavior similar to that of Li. 2 figures, 2 tables.

756 (UCID--17426-76-5) LITHIUM--WATER--AIR BATTERY PROJECT: PROGRESS DURING THE MONTH OF MAY 1976. Cooper, J.F.; Hosmer, P.K.; Homsy, R.V. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 3 Jun 1976. Contract W-7405-ENG-48. 10p. Dep. NTIS, PC A02/MF A01.

A technique was developed for the rapid and accurate determination of current efficiency for lithium dissolution through the measurement of the steady-state, nonequilibrium hydrogen gas evolution rate from closed lithium--water cells. A technique for preparing alloys of lithium through arc melting was developed. The results of the polarization studies on the first set of samples show no marked effect of Ca or Al dopants on film conductivity. A lithium--bromine analog of the lithium--water battery was discovered; the Li electrode showed an open-circuit potential of -2.85 V and a limiting current density of about 6000 A/m$^2$, and there was no gas evolution from cathode or anode. A technique of lithium production which may offer efficiency and production cost advantages over present-day high-temperature fused salt electrolysis techniques is being evaluated. 2 figures, 1 table. (RWR)

757 (UCID--17426-76-6) LITHIUM--WATER--AIR BATTERY PROJECT: PROGRESS DURING THE MONTH OF JUNE 1976. Cooper, J.F.; Hosmer, P.K.; Homsy, R.V. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1 Jul 1976. Contract W-7405-ENG-48. 7p. Dep. NTIS, PC A02/MF A01.

Investigations into the polarization of the Li electrode in LiOH at ambient temperatures were concluded. Voltammetric techniques were used to obtain a matrix of data for bulk electrolyte concentrations of 4.25 and 4.70 M LiOH at different electrolyte flow rates. The anodic limiting current density, i/sub lim/, was found to increase with flow rate. Double logarithmic plots of i/sub lim/ against flow rate for various concentrations of electrolyte are linear. As the LiOH concentration increases, i/sub lim/ decreases. The basic characteristics of the Li/LiOH(aq) electrode polarization are tabulated. Construction and modification of the stagnation point flow system continued. Arc melting was found to be a reasonable approach to the production of desired lithium-based alloys. 2 figures, 1 table. (RWR)

758 (UCID--17426-76-7) LITHIUM--WATER--AIR BATTERY PROJECT: PROGRESS DURING THE MONTH OF JULY 1976. Cooper, J.F.; Hosmer, P.K.; Homsy, R.V.; Koons, L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1 Aug 1976. Contract W-7405-ENG-48. 11p. Dep. NTIS, PC A02/MF A01.

Galvanostatic experiments were performed under constant total pressure to determine the dependence of Coulombic efficiency on system parameters such as reduced galvanic current density. The dependence of reduced total and corrosion currents and reduced total and galvanic currents on galvanic current is shown. The following conclusions were drawn: a Coulombic efficiency of 1.0 may be approached over a range of LiOH concentrations; unit Coulombic efficiencies are approached linearly with external cell current as the conditions of ''mechanical'' or ''transient'' passivation are approached; electrode polarization data indicate that energy losses due to the polarization of the Li electrode are small even at current densites where the Coulombic efficiency exceeds 0.9; hydrogen gas evolution at reduced galvanostatic currents below 1.0 results in enhanced convection of electrolyte near the Li anode. 3 figures, 1 table.

759 (UCID--17426-76-8) LITHIUM--WATER--AIR

BATTERY PROJECT: PROGRESS DURING THE MONTH OF AUGUST 1976. Cooper, J.F.; Hosmer, P.K.; Homsy, R.V. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 17 Sep 1976. Contract W-7405-ENG-48. 7p. Dep. NTIS, PC A02/MF A01.

A new method for producing lithium was investigated. In a continuous process, lithium amalgam would first be formed by reduction of aqueous $LiOH^-$ or $Li_2CO_3$. Lithium would then be electrochemically separated from the amalgam to form the pure liquid metal. Laboratory determination of the coulombic efficiency for the reaction $Li + OH^- = LiOH(aq) + e^-$ continued. The coulombic efficiency was found to approach 1.0 as the anodic diffusion-limited current density was approached. 2 figures. (RWR)

760 (UCID--17426-77-2) LITHIUM--WATER--AIR BATTERY PROJECT: PROGRESS DURING THE MONTH OF FEBRUARY 1977. Cooper, J.F.; Hosmer, P.K.; Kelly, B.E.; Krikorian, O.H.; Parrish, W.H. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 15 Mar 1977. Contract W-7405-ENG-48. 10p. Dep. NTIS, PC A02/MF A01.

The rotating disk electrode system designed to obtain a complete set of experimental data (electrode polarization and coulombic efficiency) for electrode materials is described. Preliminary experiments with the rotating disk Ca electrode yielded polarization curves for Ca dissolution. Open-circuit potentials for the disk electrodes were essentially indistinguishable from the computer interelectrode IR drop. Limiting currents were obtained in NaOH--NaCl mixtures. Tafel-like behavior was found for $Ni(O_2)$. Cooling curves were obtained in vacuo for KI--LiI eutectic composition. The following tabulations are given: cell voltage losses in the recycling process; critical data used in the calculation of energy conversion degradation of the system due to transport of Li and $LiOH \cdot H_2O$ between fixed-site recycling centers and refueling stations; and a breakdown of energy losses associated with Li production, battery discharge, and materials transport. 3 figures, 3 tables. (RWR)

761 (UCID--17426-77-3) LITHIUM--WATER--AIR BATTERY PROJECT: PROGRESS DURING THE MONTH OF MARCH 1977. Cooper, J.F.; Hosmer, P.K.; Kelly, B.E.; Krikorian, O.H.; Parrish, W.H. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 11 Apr 1977. Contract W-7405-ENG-48. 10p. Dep. NTIS, PC A02/MF A01.

The electrode behavior of the system, Ca/aq.-NaOH, NaCl, was investigated at ambient temperatures. Limiting currents were noted for intermediate concentrations of NaOH and NaCl, while rapid passivation at high ratios of NaOH to NaCl occurred. Low ratios of NaOH/NaCl yielded uncontrollable hydrogen evolution and rapid calcium dissolution. A model of the aqueous cell of the proposed system for the production of lithium was completed. The apparatus allows simultaneous determination of current efficiency and electrode polarization for the Li(Hg)/aq.-LiOH electrode upon cathodic polarization. Cooling curves indicate the existence of a LiI--KI--LiCl eutectic with a melting point of approximately 230°C; possible errors are being considered arising from artifacts of the system and possible impurities in the salts. 2 figures.

762 (UCID--17426-77-4) LITHIUM--WATER--AIR BATTERY PROJECT: PROGRESS DURING THE MONTH OF APRIL 1977. Cooper, J.F.; Hosmer, P.K.; Krikorian, O. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 20 May 1977. Contract W-7405-ENG-48. 10p. Dep. NTIS, PC A02/MF A01.

The energy efficiency of the aqueous electrolysis step in the proposed lithium production cell was experimentally determined. Coulombic efficiencies approach 100 percent above 0.7 $kA/m^2$, for amalgam concentrations of 1.0--1.2 at. percent Li, and for T = 21°C. Under these operating conditions, cell voltage is 3.1 V, and the overall energy efficiency is 82 +- 1 percent. The anodic dissolution of calcium in mixed NaOH--NaCl electrolytes was studied in the concentration region near (1.6 M NaOH, 0.05 M NaCl). It was found that passivation could be effectively prevented by additions of water-glass, $Na_2O \cdot x(SiO_2)$, x = 3--5. An oscillatory phenomenon was discovered where the potential of the calcium fluctuates with an amplitude of 0.4 V and a period of about 25 s. Under investigation are several new concepts for the high-energy-efficiency production of lithium and calcium metals. 4 figures.

763 (UCID--17426-77-5.6.7) LITHIUM--WATER--AIR BATTERY PROJECT: PROGRESS DURING THE MONTHS OF MAY--JULY. Cooper, J.F.; Hosmer, P.K.; Krikorian, O. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 16 Aug 1977. Contract W-7405-ENG-48. 19p. Dep. NTIS, PC A02/MF A01.

The abstract is included of a published report which outlines the potential role of metal/air fuel cells in automotive transportation. The energy and dolar cost of metal/air fuel cell systems is estimated, with emphasis given to the energy and dollar cost of aluminum production. Only aluminum, lithium, and (possibly) calcium are capable of providing the power for a full-performance electric vehicle, while aluminum is most favorable from the standpoint of economics. The electrochemistry of the calcium electrode appears to be similar to that of lithium, although the use of an aggressive anion (chloride) is necessary to prevent rapid passivation of the anode. Faradaic efficiencies were found to approach 100 percent close to the diffusion-limited dissolution conditions, as in the case of lithium. However, electrode polarizations of about 1.5 V under such conditions would produce an energy efficiency of discharge of about 40 percent. The two-stage electrolysis process, proposed for the efficient production of lithium, was subjected to further experimental verification. Faradaic efficiencies exceeding 95 percent were obtained for the formation of Li(Hg) from aqueous LiOH at temperatures up to 56°C at 75 $mA/cm^2$. Concentrations of Li in Hg were obtained which exceeded the liquidus solubility limit by a factor of four without serious loss of efficiency. The solubility of mercury in the candidate fused salt was determined and found to be acceptably low: 250 ppM. 5 figures, 3 tables.

764 (UCRL--51811) LITHIUM--WATER--AIR BATTERY: A NEW CONCEPT FOR AUTOMOTIVE PROPULSION. O'Connell, L.G.; Rubin, B.; Behrin, E.; Borg, I.Y.; Cooper, J.F.; Wiesner, H.J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1 May 1975. Contract W-7405-eng-48. 38p. Dep. NTIS $4.00.

AUTOMOBILES;ELECTRIC-POWERED VEHICLES;METAL-GAS BATTERIES;LITHIUM;WATER;AIR;PERFORMANCE; COMPARATIVE EVALUATIONS;CARBON DIOXIDE;CATHODES; PLANNING;ECONOMICS

765 (UCRL--52000-76-8) ENERGY AND TECHNOLOGY REVIEW. Selden, R.W.; Crawford, R.B.; Cummings, K.L.; Prono, J.K. (eds.). (California Univ., Livermore (USA). Lawrence Livermore Lab.). Aug 1976. Contract W-7405-ENG-48. 18p. Dap. NTIS $3.50.

The articles describe the electric gun, a versatile tool for studying initiation properties of explosives; microcomputers and computer networks; and the preferred parts concept, which may mean that metric conversion will pay for itself by elimination of duplication. Brief items also report on progress in geothermal programs, the lithium--water--air battery program, and uncertain conclusions in the study of ozone depletion. 6 figures. Separate abstracts are prepared for the individual articles for inclusion in the data base. (RWR)

766 (UCRL--78156) ANODIC BEHAVIOR OF LITHIUM IN AQUEOUS LITHIUM HYDROXIDE SOLUTIONS. Cooper, J.F.; Hosmer, P.K.; Homey, R.V. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 17 Oct 1976. Contract W-7405-ENG-48. 22p. (CONF-761057--1). Dep. NTIS $3.50.

From Electrochemical Society meeting; Las Vegas, Nevada, USA (17 Oct 1976).

The lithium--water battery is the prototype of a large class of primary galvanic cells which use lithium anodes, various water-based electrolytes containing dissolved oxidizing agents, and inert, suitably catalized cathodes. Water is the cathode material, and is reduced on an iron screen current collector. The purpose of this work was to determine the mass transfer dependence of the anodic half-cell reactions. Electrode polarization and coulombic efficiency were measured as a function of flow rate, current density, and electrolyte concentration. The applicability of the plane-parallel electrode configuration for batteries of the lithium--water type was evaluated. Current efficiencies of less than one indicated that the Li anode was partially consumed in a corrosion reaction which contributes no net current to the external circuit. It was found that the critical current density is the diffusion-limited anodic current density. The following conclusions were drawn: the Li electrode shows a linear polarization behavior up to a diffusion-limited current; in this linear region the rate of Li dissolution is relatively constant; as the external current is increased, the corrosion current falls off--a linear dependence of coulombic efficiency on external current results; and the plane parallel configuration seems fully suitable. 14 figures. (RWR)

767 (X--711-77-28, pp 3-9) NASA OBJECTIVES AND THE SPACE POWER PROGRAM. Mullin, J. (National Aeronautics and Space Administration, Washington, DC). Nov 1976.

From 9. annual battery workshop; Greenbelt, Maryland, USA (9 Nov 1976).

1976 Goddard Space Flight Center battery workshop.

Objectives of NASA for the space power program are reviewed. The effort is directed into solar cells and arrays, chemical energy conversion and storage, thermal energy conversion, and power conditioning. The chemical energy conversion programs include primary and secondary batteries and fuel cells. Goals of the various programs and the approach chosen to meet them are set forth. 7 figures. (RWR)

768 (X--711-77-28, pp 35-39) MANUFACTURING VARIABLES. Armantrout, J.D. (Aeronutronic Ford, Palo Alto, CA). Nov 1976.

From 9. annual battery workshop; Greenbelt, Maryland, USA (9 Nov 1976).

1976 Goddard Space Flight Center battery workshop.

The characteristics of a 20-Wh/lb Ni/Cd battery developed for the NATO III Communications Satellite are discussed. Cell negative electrode efficiency as related to cycle life is plotted; as cycle life begins to increase, there is an increase in the peak voltage that tends to stabilize, usually after 25 to 30 cycles. Lower electrode efficiency contributes to higher charge voltages. It is concluded that the negative electrode utilization variable has significant effect on the cell negative-to-positive ratio. The minimum negative electrode utilization requirement should be controlled to preclude long-term peak cell voltage problems related to inadequate overcharge capacity. 6 figures. (RWR)

769 (X--711-77-28, pp 41-54) LIGHTWEIGHT CELLS IN BATTERIES. Schulman, I. (TRW Systems, Redondo Beach, CA). Nov 1976.

From 9. annual battery workshop; Greenbelt, Maryland, USA (9 Nov 1976).

1976 Goddard Space Flight Center battery workshop.

Recent work at TRW concerned with the manufacture of light-weight Ni/Cd cell and battery systems is discussed. High-energy density electrodes made by electrochemical deposition and vacuum impregnation were evaluated; the former performed better. The battery system developed yields 21.4 Wh/kg and a 65% DOD. New technology was developed with respect to Ti end plates, Al-plated thermal shims, anodized shims for electrical insulation, and a new terminal concept. 16 figures. (RWR)

770 (X--711-77-28, pp 97-103) CELL DESIGN. Halpert, G. Nov 1976.

From 9. annual battery workshop; Greenbelt, Maryland, USA (9 Nov 1976).

1976 Goddard Space Flight Center battery workshop.

The Standard 20-Ah nickel--cadmium cell program is reviewed. The report is devoted to the Standard cell design; there are no test results as yet. 7 figures. (RWR)

771 (X--711-77-28, pp 129-137) DESIGN DETAILS, 50-AMPERE HOUR CELL. Scott, W. (TRW Systems, Redondo Beach, CA). Nov 1976.

From 9. annual battery workshop; Greenbelt, Maryland, USA (9 Nov 1976).

1976 Goddard Space Flight Center battery workshop.

Details of the design of a 50-Ah Ni/Cd cell are summarized. Drawings and a table of specifications are presented. Modifications of plates for signal electrodes are also considered. 13 figures. (RWR)

772 (X--711-77-28, pp 139-179) PANEL/ ATTENDEE DISCUSSION ON CELL DESIGN. Nov 1976.

From 9. annual battery workshop; Greenbelt, Maryland, USA (9 Nov 1976).

1976 Goddard Space Flight Center battery workshop.

This discussion centers on cell design as it relates to energy density and life reliability. Several of the panel members made brief presentations on weight distributions of battery components and their improvement, changes in crystal structure in the electrodes,

788 STORAGE BATTERY AND METHOD OF MAKING THE SAME. Dougherty, T.J.; Bast, V.W. (to Globe-Union Inc.). US Patent 4,029,855. 14 Jun 1977. Filed date 10 Dec 1975. 6p.

A secondary storage battery and process for making it involve combining folded positive and negative battery plates and separators to form battery elements, placing the elements within a battery container having partitions defining a plurality of battery cells, and joining adjacent battery elements by an intercell connection through the partition walls by welding a positive and a negative terminal through the battery case into contact with positive and negative battery plate lugs, respectively. 7 figures.

789 ELECTROCHEMICAL STORAGE CELL OR BATTERY. Fischer, W.; Haar, W.; Kleinschmager, H.; Weddigen, G. (to Brown, Boveri and Cie. AG). US Patent 4,029,857. 14 Jun 1977. Priority date 5 Dec 1974, German, Federal Republic of (F.R. Germany). 4p.

An electrochemical storage cell or battery based on sodium and sulfur has an anode chamber and a cathode chamber separated from each other by a dividing wall capable of conducting sodium ions. The cell is provided with a screening electrode disposed in the chamber containing sulfur as a reactant between the dividing wall and the outer cell wall of the chamber to screen the cell wall electrically and thereby minimize corrosion of the cell wall. 2 figures.

790 ELECTRIC CELLS. Evans, L.S.; Markin, T.L.; Dell, R.M.; Montgomery, A.G. (to The Secretary of State for Industry in Her Britannic Majesty's Government of the United Kingdom of Great Britain and Northern Ireland). US Patent 4,029,858. 14 Jun 1977. Priority date 19 Nov 1974, United Kingdom of Great Britain and Northern Ireland (UK). 6p.

In an electric cell having a solid electrolyte and employing sodium as the liquid anode and sulphur as the liquid cathode, the liquid anode is contained in two compartments separated by a corrosion-resistant barrier. Liquid anode is arranged to flow between the compartments through a flow restrictor which permits a rate of flow sufficient to meet the normal charge and discharge requirements of the cell but limits higher rates of flow. One of the compartments has a very limited capacity for liquid sodium and is disposed about one side of the solid electrolyte to define a wicking space to constrain liquid sodium to flow over the solid electrolyte. The other compartment provides a reservoir for containing the bulk of the liquid sodium. In the event of damage to the solid electrolyte, only a very limited amount of liquid sodium is readily available to mix and react with the liquid sulphur. 5 figures.

791 SEALED LITHIUM--SODIUM ELECTROCHEMICAL CELL. Farrington, G.C.; Roth, W.L. (to General Electric Co.). US Patent 4,027,076. 31 May 1977. Filed date 23 Feb 1976. 10p.

A sealed lithium--sodium electrochemical cell is described which comprises a casing, an anode positioned within the casing (the anode selected from the class consisting of lithium--sodium, lithium--sodium as an amalgam, and lithium--sodium in a non-aqueous electrolyte), a cathode positioned within the casing (the cathode functioning with a lithium--sodium-type anode and a solid lithium--sodium aluminate electrolyte), and a solid lithium--sodium aluminate electrolyte positioned within the casing between the anode and cathode and in contact with both the anode and cathode. The solid lithium--sodium aluminate electrolyte has an approximate composition of $LiNa\ 0.9Al_2O_3$, of which 1.3 to 85 percent of the total alkali ion content is lithium. 1 figure, 4 tables.

792 APPARATUS FOR CIRCULATING ELECTROLYTE AROUND MULTI-SECTION BATTERIES. Hart, T.G. (to Energy Development Associates). US Patent 4,025,697. 24 May 1977. Filed date 29 Oct 1975. 6p.

A two-stage electrolyte circulation system for a multi-cell battery is described in which a large pump distributes the electrolyte through hydraulically driven circulators to the individual cells. 2 figures.

793 MANGANESE STORAGE BATTERY. Silva, L.; Spector, G. US Patent 4,025,699. 24 May 1977. Filed date 24 Nov 1975. 4p.

An improved storage battery is composed of carbon and zinc plates with separators between them. The zinc plates are left untreated, while the carbon plates are treated with manganese dioxide. The plates are pivotally suspended and perforated for better circulation of the electrolyte solution. 5 figures.

794 BATTERY CONSTRUCTION. Nishimura, H.; Nomura, Y. (to Citizen Watch Company, Ltd.). US Patent 4,025,702. 24 May 1977. Priority date 10 Mar 1975, Japan. 6p.

A description is given of a battery having a battery cup and a battery cap which has a ridge portion to provide a battery chamber for accommodating a positive electrode, a negative electrode, and an electrolyte. The battery chamber has a contour at its outer periphery different from that of the sealing flanges of the battery cup and the battery cap. 11 figures.

795 SODIUM--SULFUR STORAGE BATTERY. Kagawa, H. (to Agency of Industrial Science and Technology). US Patent 4,024,319. 17 May 1977. Priority date 8 Oct 1974, Japan. 4p.

This invention relates to a novel sodium--sulfur storage battery comprising a sodium reservoir made of metal (incorporating a heater) between double walls, a solid electrolyte connected to it, an anodic reactant contained in it and a cathode reactant outside of it, and a battery housing which contains the above-mentioned components. The battery is sealed at the upper part. According to this invention, a sodium--sulfur storage battery having superior performance, longer service life, and of low price is obtainable.

796 BATTERY CONSTRUCTION. McDowall, W.L. (to Dunlop Australia Ltd.). US Patent 4,022,951. 10 May 1977. Priority date 25 Nov 1974, Australia. 8p.

A multicell battery comprises a plurality of frames, each divided into a number of side-by-side active paste support areas. The frames are assembled and secured together in a stacked formation so that the perimeter portions of the frames form the top, bottom, and two opposite sides of the battery, and the divisions in the frames form cell partitions. Each frame is pasted with active material to form plates, with adjacent plates in each frame being of opposite polarity and adjacent plates in each frame being of opposite polarity and adjacent plates in adjoining frames also being of opposite polarity. Electrolyte-porous separator material is provided between adjacent plates in adjoining frames. 7 figs.

797 CONTROL OF GENERATION OF CHLORINE FEED FROM CHLORINE HYDRATE FOR USE IN A METAL CHLORINE ELECTRIC ENERGY STORAGE DEVICE. Symons, P.C. (to Energy Development Associates). US Patent 4,020,238. 26 Apr 1977. Filed date 7 Apr 1975. 6p.

A simple, inexpensive, and trouble-free method of controlling the chlorine feed to a metal--chlorine battery system from a source of chlorine hydrate includes the following aspects: circulating aqueous electrolyte from an electrode compartment through a pump and back to the electrode compartment; taking off a portion of the electrolyte and passing it through a container of chlorine hydrate from which it releases chlorine and water, the chlorine generation increasing the pressure in the container; controlling the flow of electrolyte to the container; allowing the chlorine generated to flow from the container to the recycle line and back to the electrode compartment, which flow diminishes the pressure in the container, at which time electrolyte is again admitted to it. The steps are continually repeated during the discharging of a battery system. An apparatus for carrying out the process of the invention includes a check valve between the pump and the container of hydrate which closes, preventing admission of the electrolyte to the container when the pressure increases enough to threaten to force the contents back through the line in which the check valve is located.

798 SOME ASPECTS OF LITHIUM--COPPER COMPOUND CELLS IN LICL--KCL EUTECTIC. Eichinger, G. (Tech. Univ. of Munich). J. Power Sources; 1: No. 3, 237-247(Apr 1977).

The electrochemical behavior of cupric and cuprous sulfide in LiCl--KCl eutectic and possible side reactions thereof were investigated. These sulfides are valuable electrode materials showing reversible behavior during cycling. Formation of cuprous sulfide occurs if metallic copper and cupric sulfide are present together in the eutectic. Nevertheless, there seems to be a re-formation of the starting material (cupric sulfide or a defined cupric--cuprous sulfide mixture are formed in the original or a very similar composition during re-oxidation). Because of the similar potentials of the sulfides only one voltage plateau is observed during discharge. The formation of highly soluble copper chlorides and sulfur occurs at potentials well above that of the copper sulfide re-formation and, therefore, causes no problems. 8 figures.

799 SUPER BATTERIES FOR LOAD LEVELING AND ELECTRIC VEHICLES. Battery Man; 19: No. 4, 14-15(Apr 1977).

Plans to develop the zinc/chlorine battery for utility and electric vehicle use are briefly recounted. A 1-MWh system is anticipated for 1980. Nickel-zinc batteries cost less and yield more energy than lead--acid and nickel/cadmium batteries. Improved separators reduce dendrite formation and slumping. Ni/Zr batteries have yielded twice the range of lead--acid batteries. (RWR)

800 ELECTROLYTIC CELLS. Cleaver, B.; Rowlands, G.J. (to National Research Development Corp.). US Patent 4,015,054. 29 Mar 1977. Filed date 18 Aug 1975. 4p.

A lithium/chalcogen thermal cell having a ceramic electrolyte and a lithium ion-containing salt intermediate the anode and the electrolyte is described. The chalcogen is preferably selenium or sulfur and the ceramic electrolyte is preferably βalumina, or β''alumina, or $Li_4SiO_4$, or $Li_4TiO_4$. Contact between the anode and the electrolyte is prevented by the intermediate salt and the ceramic electrolyte prevents self-discharge of the cell resulting from dissolution of the electrode materials. 2 figures.

801 HIGH TEMPERATURE SECONDARY BATTERIES. Askew, B.A.; Holland, R. (to National Research Development Corp.). US Patent 4,013,818. 22 Mar 1977. Priority date 28 Sep 1974, United Kingdom of Great Britain and Northern Ireland (UK). 4p.

The invention concerns a high-temperature lithium--sulfur secondary battery. The cells of the battery are arranged in a stack. Each cell consists of a pellet of immobilized electrolyte sandwiched between a lithium-containing negative electrode pellet and a metal sulfide positive electrode. Intercell metal sheets both maintain electrical contact and inhibit chemical reaction between the electrodes of adjacent cells. The stack of cells is enclosed in a close-fitting tube of chemically inert and electrically insulating material. 2 figures.

802 WATER ACTIVATION AND PRESSURE EQUALIZATION OF ELECTROCHEMICAL BATTERIES. Kraft, D.W. (to Bunker Ramo Corp.). US Patent 4,012,234. 15 Mar 1977. Filed date 14 Jul 1975. 8p.

A battery pack is disclosed for an electrical device that is to be stored for an extended period until put into use in a body of water at some depth. The pack is comprised of fully charged batteries from which the electrolyte has been effectively removed for storing. Each battery is connected by a small tube to a reservoir containing an electrolyte-forming substance (which may be just water) or fully constituted electrolyte. Means on an inlet opens at a predetermined depth to admit water into the reservoir and force electrolyte (or just water in the case of battery plates being impregnated with electrolyte-forming substance) into the batteries. Each tube is also blocked by suitable means to hold electrolyte (or water) in the reservoir until its pressure exceeds a predetermined level. The battery pack is encased and the spaces between batteries are filled with inert pressure-equalization fluid so the outside of the batteries will be at the same pressure as the pressurized electrolyte. 4 figures, 1 table.

803 MODULAR ELECTRICAL ENERGY STORAGE DEVICE. Saunders, R.C. (to Electric Power Research Inst., Inc.). US Patent 4,012,562. 15 Mar 1977. Filed date 28 Nov 1975. 14p.

A compact modular electrical energy storage device comprises one or more cell modules in which certain components of the device are maintained in a substantially fixed position in the device by utilizing a resilient porous body of compressed carbon fibers to urge the components into physical contact with one another. The invention further provides means for maintaining the cell components in such fixed position during cell operation at elevated temperatures for extended periods of time. A preferred compact cell module construction particularly suitable for use in a high-temperature, high-energy-density lithium battery includes two positive electrode assemblies positioned in opposing relationship by a U-shaped spacer member maintained in contact with a separator member of each positive electrode assembly by a resilient porous body of compressed graphite fibers, a unitary double-faced negative electrode

assembly being positioned between the two positive electrode assemblies. 7 figures.

804 MEANS FOR DETECTING AND NEUTRALIZING LEAKS IN ELECTROCHEMICAL CELLS. Hallett, J.L.; Rollason, P.H.; Rychlewski, T.V. (to GTE Sylvania Inc.). US Patent 4,011,371. 8 Mar 1977. Filed date 17 Dec 1975. 2p.

A neutralizing agent is maintained adjacent the seal area of electrochemical cells containing corrosive electrolytes. The neutralizing agent can be kept in a pocket or depression formed in a flange next to the seal or can be contained in a suitable plastic ring which surrounds the seal. When the electrolyte is thionyl chloride and aluminum chloride, a suitable neutralizing agent is sodium carbonate. 2 figs.

805 SCRAP BATTERY PLATE RECLAIMING PROCESS. Litt, T.D.; Shelton, R.C.; Colwell, E.J. (to ESB Inc.). US Patent 4,009,833. 1 Mar 1977. Filed date 14 Aug 1975. 4p.

Lead--acid storage battery plates damaged during battery manufacture are placed in a trough having an upward slope. The trough is vibrated causing the nonmetallic components of the plates to be shaken free from the metallic components of the plates with the nonmetallic components being reduced in size during the vibration process. The nonmetallic components of the plates are discharged from the trough as a fine powder through suitable openings in the bottom of the trough, while the metallic components climb the trough and are discharged at the upper end of the trough. 2 figures.

806 SOLAR POWER PACK APPARATUS. Kazis, E.W.; Mark, R.; Wetherell, T.J. (to General Solar Power Corp.). US Patent 4,009,051. 22 Feb 1977. Filed date 10 Feb 1976. 6p.

Solar power pack apparatus adaptable for powering emergency equipment at remote locations includes a solar cell array, a rechargeable battery pack, a long shelf-life primary battery pack and switching circuitry interconnecting these elements to provide upon demand immediate and continuous supply of electrical power over extended periods of time notwithstanding environmental conditions, which would render unsuitable conventional emergency-use reserve power packs. 9 claims, 12 figures.

807 CHALCOGENIDE BATTERY. Whittingham, M.S. (to Exxon Research and Engineering Co.). US Patent 4,009,052. 22 Feb 1977. Filed date 5 Apr 1976. 8p.

A battery is provided in which the anode contains as the anode-active material a metal selected from the group consisting of Group Ia metals, Group Ib metals, Group IIa metals, Group IIb metals, Group IIIa metals, and Group IVa metals (lithium is preferred). The cathode contains as the cathode-active material a chalcoganide of the formula MZ/sub x/, wherein M is an element selected from the group consisting of titanium, zirconium, hafnium, niobium, tantalum, and vanadium (titanium is preferred); Z is an element selected from the group consisting of sulfur, selenium, and tellurium, and x is a numerical value between about 1.8 and about 2.1. The electrolyte is one which does not chemically react with the anode or the cathode and which will permit the migration of ions from the anode-active material to intercalate the cathode-active material. A highly useful battery may be prepared utilizing lithium as the anode-active material, titanium disulfide as the cathode-active material, and lithium perchlorate dissolved in tetrahydrofuran (70 percent) plus dimethoxyethane (30 percent) solvent as the electrolyte. Alternatively, the battery may be constructed in the discharged state of a cathode containing as the cathode-active material an intercalated chalcogenide in which the intercalating species is derived from the same materials previously mentioned as being useful for the anode-active material and the chalcogenide would be the same as that previously described. In this alternate type of battery, the anode may merely be a substrate (e.g., a metal grid) capable of receiving the intercalating species deposited thereon. 1 table.

808 AIR DEPOLARIZATION CELL OR BATTERY. Gerbier, G. (to Saft-Societe des Accumulateurs Fixes et de Traction). US Patent 4,009,320. 22 Feb 1977. Priority date 11 Mar 1975, France. 4p.

The invention concerns an air depolarization cell or battery. The positive electrode is supplied with air through at least one cavity formed by at least two funnels formed directly by molding or otherwise in the mass of the positive electrode separated by a portion of the mass of the positive electrode, each funnel communicating with the outside air at one of their ends and communicating together by a passageway similarly formed directly in the mass of the positive electrode at the level of their other ends. The ratio between the area of the surface of each funnel through which air flows into the electrode and the volume of air therein is different for the two funnels.

809 CHEMOELECTRIC BATTERY. Lindstrom, O.B. US Patent 4,008,099. 15 Feb 1977. Priority date 14 Mar 1975, Sweden. 18p.

A battery includes a plurality of bipolar electrodes which include a wall, positive electrode material disposed on one side of the wall, and negative electrode material disposed on another side of the wall. Electrolyte chambers separate the electrodes. At the top of each electrolyte chamber a gas lock is provided. The gas locks are interconnected by fluid conduits. The conduits communicate with the gas locks at a level disposed below the top of the electrolyte chamber. Pressure build-ups in one electrolyte chamber can thus be distributed to the gas locks of other electrolyte chambers. Hydrophobic plugs can be disposed within the conduits which permit the passage of gas, but restrict the passage of electrolyte. 10 figures.

810 STORAGE BATTERY WITH COMMON EXPANSION AND FILLER CHAMBER. Perkams, W. (to AS-Motor GmbH KG). US Patent 4,008,355. 15 Feb 1977. Priority date 19 Apr 1975, German, Federal Republic of (F.R. Germany). 4p.

To prevent differential electrolyte levels in the various cells of a storage battery having a common expansion and filler chamber, while preventing internal short circuits through the electrolyte, each cell is formed with an overflow tube extending just below the normal electrolyte level of each cell, and an inlet tube flush with the expansion and filler chamber and having general U-shape, extending first downwardly and then upwardly. The U-shaped tube is at least partly filled with electrolyte to form resistance to the flow of gases and electrolyte liquid from a particular cell back into the expansion and filler chamber through the inlet tube, rather than through the overflow tube, which extends above the wall separating the common expansion and filler chamber and the individual cell. A constriction

or fluid choke may also be included in the U-shaped tube, which is preferably constructed as a stub pipe extending from the common expansion and filler chamber into a side pocket formed at the side wall of the battery. Each pocket is in open fluid communication with the respective cell just beneath the separating wall. The pockets are molded at the outside walls of the cells of the battery box so that plates or square configurations can be inserted therein. 2 figures.

811 METHOD OF PREPARING AN ELECTROCHEMICAL CELL IN UNCHARGED STATE. Shimotake, H.; Bartholme, L.G.; Arntzen, J.D. (to Energy Research and Development Administration). US Patent 4,006,034. 1 Feb 1977. Filed date 11 Mar 1976. 10p.
PAT-APPL-665,746.
A secondary electrochemical cell is assembled in an uncharged state for the preparation of a lithium alloy--transition metal sulfide cell. The negative electrode includes a material such as aluminum or silicon for alloying with lithium as the cell is charged. The positive electrode is prepared by blending particulate lithium sulfide, transition metal powder, and electrolytic salt in solid phase. The mixture is simultaneously heated to a temperature in excess of the melting point of the electrolyte and pressed onto an electrically conductive substrate to form a plaque. The plaque is assembled as a positive electrode within the cell. During the first charge cycle lithium alloy is formed within the negative electrode and transition metal sulfide, such as iron sulfide, is produced within the positive electrode. 2 figures, 2 tables.

812 HERMETIC ALKALINE STORAGE BATTERY. Winsel, A.; Buder, E. (to Varta Batterie Aktiengesellschaft). US Patent 4,003,754. 18 Jan 1977. Priority date 7 Nov 1974, German, Federal Republic of (F.R. Germany). 6p.
Alkaline storage battery cells having negative electrodes with higher capacity than the positive electrodes are discussed. The positive electrodes have discharge-limiting capacity. The negative electrodes have additive of Raney metal, or Raney metal alloy, such cells constituting a battery.

813 RECHARGEABLE ELECTROCHEMICAL CELL. Briggs, D.C.; Hass, R.J. (to Aeronutronic Ford Corp.). US Patent 4,004,067. 18 Jan 1977. Filed date 7 Jun 1976. 6p.
A rechargeable electrochemical cell is disclosed which includes both a cathode and a gas-generating and consuming anode housed within a closed container. A storage volume is provided within the container for storing the gas used by the cell. A capillary mat lining material is provided throughout the gas storage volume of the cell. This lining material is in liquid-transfer contact with a separator and electrolyte storage material located between the electrodes of the cell. If any electrolyte (i.e. water) of the cell is vaporized into the gas storage volume, the electrolyte will condense on the lining material and be conducted back to the separator and electrolyte storage material positioned between the electrodes.

814 ELECTROCHEMICAL CELL OF A RECHARGEABLE NATURE. Briggs, D.C.; Hass, R.J. (to Aeronutronic Ford Corp.). US Patent 4,004,068. 18 Jan 1977. Filed date 7 Jun 1976. 6p.
A rechargeable electrochemical cell is disclosed which includes both a cathode and a gas-generating and consuming anode housed within a closed container. A closed volume is provided within the container for storing the gas used by the cell. A separator and electrolyte storage material is located between the electrodes of the cell. A reservoir is formed of a material capable of storing electrolyte. This reservoir is in liquid-transfer contact with the separator and electrolyte storage material between the electrodes. If any electrolyte of the cell stored in the separator and electrolyte storage material is vaporized into the gas storage volume, such electrolyte is replaced by transfer of electrolyte from the reservoir to the separator and electrolyte storage material.

815 SYSTEM FOR IMPROVING CHARGE EFFICIENCY OF A ZINC-CHLORIDE BATTERY. Berman, A.M.; Walker, R.C.; Aller, D.J. (to Energy Development Associates). US Patent 4,001,036. 4 Jan 1977. Filed date 20 Nov 1975. 6p.
A system is provided for improving the charge efficiency of a zinc--chloride battery by reducing the chlorine concentration on charge in a flowing electrolyte system by desorbing chlorine from the flowing electrolyte under reduced pressure and removing the desorbed chlorine from the electrolyte flow loop.

816 LEAD BATTERIES. Beck, F. (to Badische Anilin- and Soda-Fabrik Aktiengesellschaft). US Patent 4,001,037. 4 Jan 1977. Priority date 3 Sep 1971, German, Federal Republic of (F.R. Germany). 6p.
Lead batteries which contain lead salt solutions and/or their corresponding acids and have a titanium base plate on the positive electrode and a graphite base plate on the negative electrode are described.

817 NA/S CELL AS A SOURCE OF MOTIVE POWER FOR ELECTRIC VEHICLES. Fischer, W. (Brown, Boveri und Cie A.G., Heidelberg (Germany, F.R.). Zentrales Forschungslabor); Baukal, W. (Battelle-Institut e.V., Frankfurt am Main (Germany, F.R.)). Elektrotech. Z., A; 98: No. 1, 75-79(Jan 1977). (In German).
The fundamental questions of sodium/sulphur cells are briefly outlined and some comparative data for other battery systems are given. Research and considerable advances on long-term properties, charging densities and safety measures give some optimistic outlook that there could well be a Na-S battery for traction purposes in the future.

818 OPTIMIZATION OF THE LEAD-ACID BATTERY FOR POWERING ELECTRIC ROAD VEHICLES. Friedheim, G. (Accumulatorenfabriken Wilhem Hagen A.G., Soest (Germany, F.R.)). Elektrotech. Z., A; 98: No. 1, 61-64(Jan 1977). (In German).
A report is given on tests for the optimization of the lead accumulator for electric vehicles. The aim is to increase the specific energy (with adequate strength per cycle) and service life. For investigating this function systematic tests were made with different plate thicknesses and suitable plate surface. Further improvements were made by such factors, as the specific energy, which give low maintenance for the lead battery. Improved properties can be achieved by the construction and material of the casing and supports, and of the plate insulation.

819 TRACTION BATTERIES FOR EXISTING AND FUTURE ELECTRIC ROAD VEHICLES. Salamoon, K.; Kraemer, G. (Varta Batterie A.G., Kelkheim (Germany, F.R.). Forschungs- und Entwicklungszentrum). Elektrotech. Z., A; 98: No. 1, 69-74(Jan 1977). (In German).

In the first part of the contribution a new lead traction battery is described, and in the second part a new nickel--iron traction battery. Basic and constructional measures for increasing the specific energy to about 40 Wh/kg for the lead accumulator and to about 50 Wh/kg for the nickel-iron battery are aimed in the main at reducing the dead-weight components and the voltage drops in the current-carrying components. Corresponding with the more advanced state of development of the new lead accumulator, actual figures are given for electrical operation of an assemblage of batteries, while for the nickel-iron accumulator, which is at a fairly early stage of development, the problems relate more to the solution of basic characteristics and the development of smaller units. The possibilities of further development are outlined.

820 DEVELOPMENT OF ELECTROCHEMICAL POWER SOURCES FOR ELECTRIC TRACTION. Vielstich, W. (Bonn Univ. (Germany, F.R.). Inst. fuer Physikalische Chemie). Elektrotech. Z., A; 98: No. 1, 79-82(Jan 1977). (In German).

Some research and development work on secondary batteries for electrotraction and load levelling supported by the German Government is described. This includes lead-acid and nickel-iron cells as well as sodium-sulfur batteries. Technical problems and the possible applications are discussed.

821 CHRYSLER LONG LIFE BATTERY CONCEPT. VanHalteren, C.J. Warrendale, PA; Society of Automotive Engineers (1977). 9p. (CONF-770205--30).

From Conference of the SAE International Automotive Engineering Congress and Exposition; Detroit, Michigan, USA (28 Feb 1977).

The Chrysler Long Life Battery Concept Paper covers the establishing of the causes for batteries being removed from service, the determination of the cause for removal, and the design changes in the battery and its electrical and thermal environment to create the Long Life Battery Concept. The test shows the importance of controlling the vehicle environment as well as the battery construction in accomplishing the goal. 13 figures, 2 tables.

822 NEW DESIGN FOR THE HIGH-PERFORMANCE SODIUM--SULFUR BATTERY. Hattori, S.; Yamaura, M.; Kimura, S.; Iwabuchi, S. Warrendale, PA; Society of Automotive Engineers (1977). 9p. (CONF-770205--39).

From Conference of the SAE International Automotive Engineering Congress and Exposition; Detroit, Michigan, USA (28 Feb 1977).

This paper describes a new design for the sodium--sulfur battery employing a new cell construction including a new method to join the solid electrolyte tube with the sodium reservoir made of metal, and an improved composition of the cell case to solve the problems of premature cell destruction and capacity decrease associated with the conventional design. A higher and more stable performance of the new design than that of the conventional design was shown through various evaluation tests. 11 figures, 7 tables.

823 SOME UK PROGRESS IN SODIUM--SULFUR TECHNOLOGY. Lomax, G.R. Warrendale, PA; Society of Automotive Engineers (1977). 8p. (CONF-770205--40).

From Conference of the SAE International Automotive Engineering Congress and Exposition; Detroit, Michigan, USA (28 Feb 1977).

Some progress made in the UK on sodium--sulfur cells designed for motive power applications is described. This is an area where compatibility with vehicle design imposes design constraints on the cell. The state of the art of the cell components is reviewed. Most of the design problems associated with the sodium electrode have been solved. Electrolyte 33 mm dia and over 500 mm long can now be produced, and the strength and conductivity can be controlled. Factors controlling the rechargeability of the sulfur electrode were studied, and 90 percent capacity retention was achieved for 8000 hours without any deterioration of performance. A 100-Ah cell completed 60 charge--discharge cycles without any significant deterioration of performance. 8 figures, 4 tables.

824 SLIG BUYER'S GUIDE, 1977. STARTING, LIGHTING, IGNITION, AND GENERATING SYSTEMS. Noe, D.A. (ed.). Battery Man; Special Issue: 1-72(1977).

This buyers' guide lists manufacturers of batteries, components, and support materials and equipment in the U.S. and 91 other countries. Entries are listed geographically, alphabetically, and by product. (RWR)

825 FUEL CELL-SECONDARY CELL COMBINATION. Baker, B.S.; Camp, R.N. (to Secretary of the Army). US Patent 4,000,003. 28 Dec 1976. Filed date 2 Jan 1976. 4p.

A hybrid fuel cell secondary battery system suitable for low power sensor applications is provided. The system comprises in combination a fuel cell, a fully contained fuel and oxidant source for the fuel cell, a DC to DC power processor for boosting the voltage output from the fuel cell, and a nickel-cadmium battery in parallel with the output from the DC to DC processor to sustain peak power drains. 9 claims, 2 figures.

826 BATTERY DESIGN. Wittmann, A. (to Hughes Aircraft Co.). US Patent 4,000,350. 28 Dec 1976. Filed date 17 Mar 1975. 4p.

A battery comprises a battery vessel, battery plates having a central aperture, electrolyte-impregnated separator, a battery plate holder, and a battery plate retainer. The battery plate holder comprises a base retainer and a central tube protruding from the base retainer. The battery plates are placed onto the battery plate holder by inserting the central tube through the apertures in the battery plates. The battery plate retainer holds the plates onto the battery plate holder, and the complete assembly comprising the battery plates, the holder, and cover is mounted with the battery vessel by coupling the base plate of the holder to the interior of the vessel. 5 figures.

827 METHOD FOR THE FABRICATION OF A HIGH-TEMPERATURE SECONDARY CELL. Werth, J.; Crouch, D.A.; Sklarchuck, J.C. (to ESB, Inc). German(FRG) Patent 2,613,882/A/. 23 Dec 1976. 23p. (In German).

1 fig..

In the fabrication of high temperature secondary cells with alkali metal (preferably sodium) as reactant of the negative electrodes, with alkali metal cation (preferably sodium ion-

-conducting separators (e.g. β-aluminium oxide), and with certain metal or metal oxide halides (preferably sodium aluminium chloride) as salt electrolytes, difficulties arise due to the influence of air oxygen and/or air moisture on the salt melt electrolytes, the positive and/or negative reactants. The present invention makes use of a series of process steps and techniques, as well as of materials (including their mixture ratios), which enable all solid components required for such cells to be introduced into the appropriate cell section under normal environmental conditions and to bring them there into the required electrochemically reactive state.

828 HIGH VOLTAGE ORGANIC ELECTROLYTE BATTERIES. Dey, A.N. (to P. R. Mallory and Co. Inc.). US Patent 3,998,658. 21 Dec 1976. Filed date 31 Jan 1975. 4p.

The solubility and reactivity of $CrO_3$ with the commonly used nonaqueous organic electrolytes used for high-voltage electrochemical cells is overcome by forming an intercalation compound of $CrO_3$ with graphite. The catnodes of such intercalation compounds, methods of making them, and cells containing such electrodes are described. In addition, it was found that cells containing such $CrO_3$ cathodes are readily rechargeable, and thus provide an excellent secondary battery. 3 figures.

829 MODULAR ELECTRICAL ENERGY STORAGE DEVICE. Saunders, R.C. (to Electric Power Research Inst.). US Patent 3,997,363. 14 Dec 1976. Filed date 7 Oct 1974. 14p.

A compact modular electrical energy storage device comprises one or more cell modules in which certain components of the device are maintained in a substantially fixed position in the device by utilizing a resilient porous body of compressed carbon fibers to resiliently urge the components into physical contact with one another. The invention further provides means for maintaining the cell components in such fixed position during cell operation at elevated temperatures for extended periods of time. A preferred compact cell module construction particularly suitable for use in a high-temperature, high-energy-density lithium battery includes two positive electrode assemblies positioned in opposing relationship by a U-shaped spacer maintained in contact with a separator of each positive electrode assembly by a resilient porous body of compressed graphite fibers, a unitary double-faced negative electrode assembly being positioned between the two positive electrode assemblies.

830 VEHICLE STORAGE BATTERY CELL. Trippe, G.; Brinkman, J. (to Varta Batterie Aktiengesellschaft). US Patent 3,996,065. 7 Dec 1976. Priority date 12 Nov 1973, German, Federal Republic of (F.R. Germany). 4p.

The plates of lead storage battery cells are supported at least from the top by resilient means attached to the cell cover. They may also be supported by resilient means from the cell bottom. The respective resilient means are placed diagonally relative to each other. At least the bottom support means has variable resiliency depending on the external forces applied to the cell. 3 figures.

831 BATTERIES FOR THE '80S: THE MATERIALS OF ENERGY STORAGE. Met. Mater.; 36-38(Dec 1976).

A growing interest in storage batteries has been sparked by two recent developments--the need to smooth the loads on generating stations, and the demand for pollution-free, battery-driven road vehicles. The article outlines the construction and performance of existing and novel secondary battery schemes with special reference to the materials aspect.

832 SECONDARY BATTERY WITH SEPARATE CHARGE AND DISCHARGE ZONES. Ludwig, F.A. (to Ford Motor Co.). US Patent 3,994,745. 30 Nov 1976. Filed date 30 Jan 1976. 22p.

A secondary battery has the following components: discharge and charge zones containing alkali metal/sulfur cells, the cells in the discharge zone being adapted to operate in a discharge mode and having an electrode which is more readily wet by molten sulfur than by molten polysulfide salts of the alkali metal, and the cells in the charge zone being adapted to operate in a charge mode and having an electrode which is more readily wet by molten polysulfide salts of the alkali metal than by molten sulfur; a storage zone adapted to store molten sulfur and molten polysulfide salts from the cells; means for transporting reactant materials including molten sulfur and molten polysulfide salts of the alkali metal between the storage zone and the charge and discharge zones; and means for transporting molten alkali metal from the charge zone to the discharge zone. 7 figures.

833 METAL HALOGEN HYDRATE BATTERY SYSTEM. Bjorkman, H.K. Jr. (to Energy Development Associates). US Patent 3,993,502. 23 Nov 1976. Filed date 29 Oct 1975. 8p.

A metal--halogen--hydrate electrical energy system having two fluid flow loops operating in parallel driven from the same pump is described. 3 figures.

834 POWER CELL. von Alpen, U.; Rabenau, A.; Fenner, J.; Marcoll, J. (to Max-Planck-Gesellschaft zur Foerderung der Wissenschaften e.V., Goettingen (Germany, F.R.)). German(FRG) Patent 2,519,351/A/. 11 Nov 1976. 7p. (In German).

The patent specification claims a solid electrolyte of tellurium subhalides, which becomes ion conductive from the effect of heat below 150°C, the use of at least one tellurium electrode in the power cell and the production of tellurium electrodes made of crystalline tellurium subhalides by melting using arc or plasma discharge. Furthermore, the special power cell combination Ag/AgI/α-TeI/Te is claimed.

835 ALKALI METAL/SULFUR CELL. Tilley, A.R.; Hames, M.D.; Sudworth, J.L.; Bird, J.M. (to British Railways Board). German(FRG) Patent 2,617,930/A/. 4 Nov 1976. 27p. (In German).

5 figs..

By a series of designs and arrangements of cell parts of cylindrical alkali metal-sulphur cells with separate storage container for the liquid alkali metal, the operational safety and the functionality is to be increased. The alkali metal flow, the elimination of electrode short circuits, cell sealing as well as the inner and outer electrical contacting are paid attention to in particular.

836 SEALED LITHIUM--REDUCIBLE GAS CELL. Roth, W.L.; Farrington, G.C. (to General Electric Co.). US Patent 3,989,538. 2 Nov 1976. Filed date 19 Mar 1975. 8p.

A sealed lithium--reducible gas cell is described which comprises a casing, an anode

positioned within the casing (the anode selected from the class consisting of lithium, lithium as an amalgam, and lithium in a nonaqueous electrolyte), a cathode positioned within the casing (the cathode consisting of a reducible gas in a nonaqueous electrolyte with an ionic conductivity-enhancing material), and a solid lithium--sodium aluminate electrolyte positioned within the casing between the anode and cathode and in contact with both the anode and cathode (the solid lithium--sodium aluminate electrolyte having an approximate composition of $LiNaO-9Al_2O_3$ of which 1.3 to 85 percent of the total alkali ion content is lithium).

837 MARKET PLACE: AMERICA RUSHES SCREAMING INTO MAINTENANCE-FREE. Battery Man; 18: No. 11, 2-3(Nov 1976).

The position of ''maintenance-free'' batteries in today's market is reviewed. Views of various manufacturers on Pb--Ca--Sn and Pb--Sb electrodes are summarized. Forecast use of Pb--Ca--Sn in 1980--1981 is tabulated. 3 tables (RWR)

838 SODIUM--MIXTURE OF METAL HALIDES, SULFUR BATTERY. Sklarchuk, J.C. (to ESB Inc.). US Patent 3,988,163. 26 Oct 1976. Filed date 9 Jun 1975. 8p.

A secondary battery utilizes a molten sodium negative reactant, a mixture of metal halides and sulfur as positive reactant melt having a carbon powder dispersed within the melt, a molten sodium haloaluminate electrolyte, and a selectively ionically conductive separator positioned between the negative and positive reactants. 3 figures

839 METHOD OF MAKING A LEAD--ACID STORAGE BATTERY, AND CELL, CAPABLE OF ACTIVATION BY THE ADDITION OF ELECTROLYTE. Mao, G.W. (to Gould Inc.). US Patent 3,988,165. 26 Oct 1976. Filed date 6 Oct 1975. 22p.

A method of fashioning a lead--acid storage battery capable of being stored after completion of the battery processing and thereafter activated by the addition of electrolyte includes adding conditioning quantities of a treating agent affording certain metallic sulfates to the formation electrolyte, a rinse electrolyte, or a separate solution to obviate the necessity for removing, as by drying, all or substantially all of the electrolytes used to process the battery. Sufficient electrolyte is removed simply by draining, and the resulting battery can be stored for extended periods of time without significantly adversely affecting the performance of the activated battery. 3 figures, 10 tables.

840 ELECTRIC BATTERY WITH MULTI-CELL STACK ISOLATION. Ciliberti, F.L. Jr. (to P. R. Mallory and Co., Inc.). US Patent 3,986,894. 19 Oct 1976. Filed date 29 Apr 1974. 8p.

A construction which minimizes damage to alkaline electrolyte batteries due to electrolyte leakage caused by extreme variations in temperature is disclosed. The batteries comprise a multiplicity of individually sealed cells, arranged in electrically connected stacks, each stack being disposed in a moisture-proof plastic container and/or cup filled with an encapsulating resin in the entire space within the cup, with the encapsulated assembly being housed in a metal outer container. The cells within each stack and each stack itself is thus isolated, this isolation minimizing any damage that might result from intercell leakage, from interstack leakage, and from leakage that would corrosively affect associated equipment in an assembled apparatus, due to extreme temperature variations, especially under high humidity conditions. 5 figures.

841 CELL WITH CIRCULATING ELECTROLYTE. Stachurski, Z.; Yardney, M.N. (to Yardney Electric Corp.). US Patent 3,985,581. 12 Oct 1976. Filed date 31 Jul 1970. 6p.

To prevent the formation of internal short circuits between electrodes of a rechargeable electrochemical cell, the electrolyte is maintained in continuous motion, at least during charging. In the case of an air-depolarized cell with a positive oxygen electrode and a negative zinc electrode, an air stream is introduced into a cylindrical cell casing through a multiplicity of orifices in a generally tangential direction and at increasing distances from the housing axis to impart rotation about that axis to the liquid. Upon subsequent discharge, a valve redirects the air stream into a compartment separated from the electrolyte by the oxygen electrode.

842 SECONDARY BATTERY OR CELL WITH DUAL ELECTRODE. Ludwig, F.A. (to Ford Motor Co.). US Patent 3,985,575. 12 Oct 1976. Filed date 30 Jan 1976. 22p.

An improved secondary battery or cell has the following characteristics: one or more anodic reaction zones containing a molten alkali metal reactant-anode in electrical contact with an external circuit; one or more cathodic reaction zones containing a cathodic reactant which, when the battery or cell is at least partially discharged, are selected from the group consisting of a single-phase composition comprising molten polysulfide salts of the anodic reactant and a two-phase composition comprising molten sulfur and molten sulfur-saturated polysulfide salts of the anodic reactant; a cation-permeable barrier to mass liquid transfer interposed between and in contact with the anodic and cathodic reaction zones; and electrode means within the cathodic reaction zone for transporting electrons to the vicinity of the cation-permeable barrier during discharge and for transporting electrons away from the vicinity of the barrier during charge, the electrode being in contact with both cation-permeable barrier and external circuit and being immersed, at least in part, in the cathodic reactant. The improvement of the invention comprises an electrode means which comprises first and second electrodes. The first electrode is adapted to be used in charging the battery or cell, disposed in a first region of the cathodic reaction zone, contiguous with or adjacent to a first section of the cation-permeable barrier, and formed of a conductive material which is more readily wet by molten polysulfide than by molten sulfur. The second electrode is adapted to be used in discharging the battery or cell, disposed in a second region of the cathodic reaction zone, contiguous with or adjacent to a second portion of the cation-permeable barrier, and formed of a material which is more readily wettable by molten sulfur than by molten polysulfide.

843 STORAGE BATTERIES: THE CASE AND THE CANDIDATES. EPRI J.; 1: No. 8, 6-13(Oct 1976).

Efforts now under way to develop long-lived low-cost batteries for utilities are described. For electric utilities, load leveling involves, at the very least, the trade-offs in capital and operating costs between battery energy

storage and the oil-fired combustion turbines now most frequently used to drive ''peakers'', the generators that must be cut in for just the few hours each day when demand is highest. For battery chemists, the reality of load-leveling batteries necessarily involves a new, more stringent set of performance, life, and cost requirements.

844 SECONDARY ELECTROCHEMICAL CELL HAVING NON-CONSUMABLE SILICON CATHODE. Hoekje, H.H.; Dietz, P.L. (to PPG Industries, Inc.). US Patent 3,982,960. 28 Sep 1976. Filed date 31 Mar 1975. 10p.

A secondary cell for the generation of electrical power, having a nonconsumable silicon cathode collector, is described. 2 figures, 2 tables.

845 SODIUM-SULPHUR BATTERY CELLS. Partridge, B.A.; Jenkins, T.R.; McGuire, M. (to Secretary of State for Industry in Her Britannic Majesty's Government). US Patent 3,982,959. 28 Sep 1976. Priority date 11 Mar 1974, United Kingdom of Great Britain and Northern Ireland (UK). 4p.

In a sodium--sulfur battery cell of tubular form, the sulfur compartment is provided inside a tubular solid electrolyte. The sodium compartment is provided by the annular space between the solid electrolyte and a metal casing. A carbon current collector extends into the sulfur compartment. A stainless steel mesh disposed in the sodium compartment adjacent to the solid electrolyte acts as a wick for sodium. 1 figure.

846 ALKALINE CELL WITH DOUBLE COLLECTOR POSITIVE, NEGATIVE, AND THIRD TERMINAL CONNECTIONS. Beatty, T.R. (to Union Carbide Corp.). US Patent 3,982,966. 28 Sep 1976. Filed date 17 Mar 1975. 16p.

An alkaline cell is described wherein at least a pair of flat electrode elements of opposite polarity have a porous separator containing the alkaline electrolyte interposed between them. The elements are arranged in the form of a conventional electrode stack assembly. The electrode assembly is enclosed within a sealed, liquid-impervious plastic film envelope having a positive, negative, and third terminal connection in the walls thereof. Each terminal connection comprises flat internal and external current collectors disposed adjacent to the inner and outer sides, respectively, of the walls overlying openings therein. The collectors are tightly adhered to the respective sides of the walls by thin layers of an adhesive sealant which is nonwettable by the alkaline electrolyte. Means are provided for making electrical connection between the current collectors through the openings in the walls of the envelope. 7 figures.

847 PROCESS FOR PRODUCING ELECTRIC CURRENT BY THE ELECTROCHEMICAL OXIDATION OF AN ACTIVE ANODIC METAL, ESPECIALLY ZINC. Doniat, D.; Porta, A.; Bugnet, B. (to Societe Anonyme Automobiles). US Patent 3,981,747. 21 Sep 1976. Priority date Aug 1971, France. 8p.

A process for producing electric current by the electrochemical oxidation of an active anodic metal dispersed in an alkaline electrolyte is described. The electrolyte is circulated into contact with a second metal which is more electronegative than the active metal. A displacement reaction precipitates the active metal from its soluble oxidation products. There is obtained as a result a repeated recovery for reuse of the active metal (zinc) with the aid of the more electronegative metal (aluminum), which then supplies the energy for the production of current and is oxidized to form soluble products. The process is exemplified by zinc as the active metal and aluminum and magnesium as the strongly electronegative metals. 1 fig.

848 AUTOMATED POST BURN STATION. Eberle, W.J. (to General Battery Corp.). US Patent 3,980,126. 14 Sep 1976. Filed date 2 Oct 1975. 22p.

An automated apparatus for sequentially forming integrally fused battery terminals on a plurality of storage batteries is described wherein a head having a mold adjustably mounted on it is automatically movable with respect to a vertical axis. Slidably mounted on the head is a burning means for automatically producing a variable-intensity flame for melting the battery elements to form the integrally fused battery terminal during a vertical stroke. An automated post burn station is further described which has a conveyor for advancing batteries sequentially to the burning station and for aligning the batteries with respect to the station for the above-described fusing process. A plurality of novel sensors incorporated into the automated post burn station facilitates the rapid, automatic processing of batteries while providing a high degree of safety and reliability.

849 ENERGY CONVERSION DEVICES WITH IMPROVED ELECTRODE SHAPES. Ludwig, F.A.; Minck, R.W.; Weiner, S.A. (to Ford Motor Co.). US Patent 3,980,496. 14 Sep 1976. Filed date 29 Jan 1975. 16p.

An improved electrical conversion device comprises an anodic reaction zone containing a molten alkali metal reactant-anode in electrical contact with an external circuit; a cathodic reaction zone containing a cathodic reactant comprising a liquid electrolyte which is electrochemically reactive with the anodic reactant and an electrode of porous conductive material which is at least partially immersed in the cathodic reactant; and a cation-permeable barrier to mass liquid transfer interposed between and in contact with the anodic and cathodic reaction zones, the porous conductive material being in electrical contact with both the cation-permeable barrier and an external circuit. The improvement of the invention comprises a modification of the cathodic reaction zone such that there is a plurality of channels and/or spaces within the zone which are free of the porous conductive material and which, in combination with the porous conductive material, are adapted to allow flow within the cathodic zone of the cathodic reactant and cathodic reaction products during operation. 22 figures.

850 METHOD AND DEVICE FOR CONNECTING ELEMENTS OF A FORCED FLOW ELECTROCHEMICAL STORAGE CELL. Pompon, J.P. (to Compagnie Generale d'Electricite). US Patent 3,979,222. 7 Sep 1976. Priority date 5 Apr 1975, France. 4p.

An electrochemical storage cell is formed by connecting elements in hydraulic and electric series and, in each of the elements, in electrically insulating the inside of the negative end fitting situated hydraulically the nearest to the following element. In this way, the interference transfer of charges resulting from the electric series connection of two neighboring elements can be effected only by ionic conduction in the electrolyte flowing between the two elements. The invention is used in air--zinc cells. 1 figure.

851 SODIUM--WATER PRIMARY CELL WITH A ROTATING CATHODE. Fustier, D.A.; Graydon, W.F.; Foulkes, F.R. (Univ. of Toronto). J. Electrochem. Soc.; 123: No. 9, 1259-1261(Sep 1976).

A primary cell utilizing the direct reaction of sodium metal with water is described. The cell was capable of delivering steady-state current densities in excess of 40 A/cm² at an output voltage of 0.3 V. The cell mechanisms and the effects of several operating parameters such as sodium-feed rate and rotational speed of the steel disk cathode are discussed.

852 FLAT ALKALINE CELL WITH POSITIVE AND NEGATIVE TERMINAL CONNECTIONS AND A THIRD TERMINAL CONNECTION FOR AN AUXILIARY ELECTRODE. Beatty, T.R.; Vourlis, H. (to Union Carbide Corp.). US Patent 3,977,906. 31 Aug 1976. Filed date 17 Mar 1975. 14p.

A flat alkaline cell is described. An electrode assembly includes at least a pair of flat electrode elements of opposite polarity having a porous separator containing an alkaline electrolyte interposed between them and a current collector disposed adjacent to and in electrical connection with one of the pair of electrode elements at one end of the electrode assembly. The above are enclosed within a sealed, liquid impervious plastic film envelope having an opening in one wall. The opening exposes at least a portion of the current collector for making external electrical connection. A layer of an adhesive sealant which is non-wettable by the alkaline electrolyte tightly adheres and seals together the current collector and the wall of the envelope, at least around the periphery of the opening. The exposed portion of the current collector constitutes a first terminal connection to which a wire lead or the like may be attached. A second and third terminal connection are provided in the sealed envelope, the former being in electrical connection with the other of the pair of electrode elements of opposite polarity and the latter being in electrical connection with an auxiliary electrode. 10 figures.

853 FORCED-FLOW ELECTROCHEMICAL BATTERY. Jacquelin, J. (to Compagnie Gererale d'Electricite). US Patent 3,977,903. 31 Aug 1976. Priority date 6 Dec 1973, France. 8p.

The invention comprises the grouping of a battery into modules fed in series with a potassium hydroxide solution containing zinc in suspension. It further comprises the grouping of the modules into an even number of assemblies in which the modules are connected in series, the assemblies having the same number of modules and being interconnected in parallel, so that, more particularly, the potential of the solution conveyed from a storage tank is equal to the potential of the solution which is made to flow back into the tank after having crossed through the modules. 5 figures.

854 NICKEL--ZINC ALKALINE STORAGE BATTERY. Sekido, S.; Ohhira, T.; Ikeda, Y.; Yokoyama, T. (to Matsushita Electric Industrial Co., Ltd.). US Patent 3,976,502. 24 Aug 1976. Filed date 17 Dec 1974. 8p.

An alkaline storage battery is described which comprises a nickel positive electrode, a zinc negative electrode, a separator which wraps the negative electrode and comprises from inside to outside in sequance: nonwoven cellulose disposed on the negative electrode, a semi-permeable membrane of cellulose and microporous plastic film which is in contact with the positive electrode, an electrolyte consisting of aqueous solution of KOH which is held on the positive and negative electrodes and in the separator and is controlled in an amount such that free electrolyte does not exist in places other than at the three elements mentioned above, and a gas phase reaction catalyst which is provided in a space in the storage battery to promote the reaction between oxide and hydrogen evolved at the end of charging.

855 SEALED LITHIUM--IODINE CELLS. Farrington, G.C.; Roth, W.L. (to General Electric Co.). US Patent 3,976,504. 24 Aug 1976. Filed date 23 Jun 1975. 8p.

A sealed lithium--iodine cell is described which comprises a casing and an anode, a cathode, and an electrolyte positioned within the casing. The anode is selected from the class consisting of lithium, lithium as an amalgam, and lithium in a non-aqueous electrolyte. The cathode is selected from the class consisting of iodine and iodine with an ionic conductivity-enhancing material. A solid lithium--sodium aluminate electrolyte is positioned between the anode and cathode and in contact with both the anode and cathode. The solid lithium--sodium aluminate electrolyte has an approximate composition of $LiNaO.9Al_2O_3$, of which 1.3 to 85 percent of the total alkali ion content is lithium.

856 METAL-GAS BATTERY WITH AXIAL REACTANT GAS STORAGE CAVITY. Warnock, D.R. (to Secretary of the Air Force). US Patent 3,975,210. 17 Aug 1976. Filed date 27 Mar 1975. 6p.

The structure of a cell for a metal--gas battery is disclosed. The cell components comprising the electrodes, separators, and electrolyte reservoirs are substantially planar structures, circular in shape and having a hole at the center. These components are stacked on a common axis perpendicular to their planar surfaces to form individual electrochemical cells. Individual cells may be similarly stacked to form a battery. The stack of flat ring-shaped components comprising a cell is enclosed in a plastic insulating cell case which provides a reactant gas manifold space at the inner circumference of the cell stack components inside the plastic enclosure. On the inner circumference of the plastic cell case are positioned ports covered with a non-wetting porous plastic membrane of Teflon. The porous membrane allows the reactant gas to pass freely through the port from the main axial reactant gas storage space in the center cavity of the cell into the manifold volume, but will not allow liquid electrolyte to pass through the membrane and escape from the cell stack. The cell (or battery) is enclosed in a conventional pressure vessel having conventional electrical connections. 3 figures.

857 RECHARGEABLE BATTERY WHICH COMBATS SHAPE CHANGE OF THE ZINC ANODE. Cohn, E.M. (to National Aeronautics and Space Administration). US Patent 3,972,727. 3 Aug 1976. Filed date 13 Aug 1975. 4p.

A rechargeable cell or battery is provided in which shape change of the zinc anode is combatted by profiling the ionic conductivity of the paths between the electrodes so that ion flow is greatest at the edges of the electrodes and least at the centers thereof, thereby reducing migration of the zinc ions from edges to the center of the anode. A number of embodiments are disclosed, wherein the strength

and/or amount of electrolyte, and/or the number and/or size of the paths provided by the separator between the electrodes, are varied to provide the desired ionic conductivity profile. 5 figures.

858 STORAGE BATTERY. Tsygankov, M.S.; Bitjutskaya, N.A.; Fateeva, V.N.; Kosholkin, V.N. Karev, B.D.; Kudinov, V.A.; Kholkin, M.M.; Moiseev, N.N.; Malandin, O.G. US Patent 3,972,736. 3 Aug 1976. Priority date 26 Feb 1973, Union of Soviet Socialist Republics (USSR). 4p.

The container of a storage battery accommodates series-connected cells whose jars are filled with electrolyte and contain plate groups assembled from plates with the aid of elements which fasten the terminal posts to the plates. The internal surfaces of two opposite walls of the jar facing the surfaces of the end plates of the plate group are provided with vertical ribs ensuring circulation of electrolyte in the electrolyte layer around the plate group. Each cell has a dielectric plate which rests freely on the elements fastening the terminal posts to the plates. 4 figures.

859 RECHARGEABLE BATTERY WITH CURRENT LIMITING MEANS. Hammel, R.O. (to Gates Rubber Co.). US Patent 3,972,739. 3 Aug 1976. Filed date 28 Nov 1975. 4p.

An enclosure battery, such as a rechargeable lattern battery, and a recharge jack mounted in the enclosure are described. The device includes a low-resistance, high-power current-limiting means connected between one of the output terminals and the corresponding polarity terminal of the battery. It is provided with heat-indicating means for determining if the output terminals of the battery have been short-circuited. 1 figure.

860 METHOD AND APPARATUS FOR ELECTROCHEMICAL GENERATION OF POWER FROM CABONACEOUS FUELS. Anbar, M.; McMillen, D.F.; Weaver, R.D.; Jorgensen, P.J. (to Stanford Research Inst.). US Patent 3,970,474. 20 Jul 1976. Filed date 11 Aug 1975. 6p.

Method and apparatus are described for the pollution-free generation of electrical power from carbonaceous fuels. Molten lead is electrochemically oxidized to produce lead oxide and electricity in a single integrated cell in which the resulting lead oxide is simultaneously converted back to lead metal by carbothermic reduction with a carbonaceous fuel. The entire process is carried out in a single cell using a molten carbonate as electrolyte in a temperature range of 500° to 900°C. The entire cycle thus consumes only carbon and oxygen and produces electricity. It is found that, by thus coupling the electrochemical cell and the thermochemical regeneration system, the resulting integrated carbon--lead--air cell will maintain a voltage well above that provided by a simple lead--air cell, and indeed approach that of a hypothetical carbon--air cell. 2 figures.

861 MOLTEN SALT ELECTROCHEMICAL SYSTEMS FOR BATTERY APPLICATIONS. Mamantov, G.; Marassi, R.; Chambers, J.Q. (to Secretary of the Army). US Patent 3,966,491. 29 Jun 1976. Filed date 13 Feb 1975. 4p.

A molten salt electrochemical system for battery applications is provided comprising aluminum as the anode, positive oxidation states of either iodine or sulfur as the cathode, and a low-melting-point molten mixture of aluminum chloride and alkali chloride disposed between the anode and cathode and in contact with each.

862 SODIUM SULFUR BATTERY OR CELL WITH IMPROVED AMPERE-HOUR CAPACITY. Ludwig, F.A. (to Ford Motor Co.). US Patent 3,966,492. 29 Jun 1976. Filed date 20 Aug 1975. 12p.

An improved secondary battery or cell comprises the following components: (A) One or more anodic reaction zones contain a molten alkali metal reactant-anode in electrical contact with an external circuit. (B) One or more cathodic reaction zones contain (1) a cathodic reactant which, when the battery or cell is at least partially discharged, is selected from the group consisting of a single-phase composition comprising molten polysulfide salts of the anodic reactant and a two-phase composition comprising molten sulfur and molten sulfur saturated polysulfide salts of the anodic reactant and (2) an electrode of porous conductive material which is at least partially filled with the cathodic reactant. (C) A cation-permeable barrier to mass liquid transfer is interposed between and in contact with the anodic and cathodic reaction zones, the porous conductive material being in electrical contact with both the cation-permeable barrier and an external circuit. The improvement comprises the following: employing a porous conductive material which will wick both sulfur and alkali metal polysulfides and which, in different regions of the cathodic reaction zone, exhibits different degrees of wettability by the alkali metal polysulfides, the material in a region adjacent to the cation-permeable barrier being more readily wetted by the polysulfides than is the material in a region further removed from the barrier such that sulfur will boil near the barrier and condense away from it;disposing the porous conductive material within the cathodic reaction zone such that it forms and encloses one or more channels which extend from the region adjacent the cation-permeable barrier outward into the region of the cathodic reaction zone which is further removed from the barrier; and maintaining the amount of molten cathodic reactant within the cathodic reaction zone such that the channels remain free of the molten reactant and are thus adapted to transport sulfur vapor. 3 figures.

863 LEAD DIOXIDE--ZINC RECHARGEABLE-TYPE CELL AND BATTERY AND ELECTROLYTE THEREFOR. Villarreal-Dominguez, E. US Patent 3,964,927. 22 Jun 1976. Filed date 10 Oct 1974. 6p.

A lead dioxide--zinc rechargeable-type cell comprises at least one positive lead dioxide plate and at least one negative amalgamated zinc metal plate spaced from the positive plate and parallel to it. Both plates are permanently submerged in an aqueous acid electrolytee containing soluble zinc salts, a zinc surface-controlling agent, an electrolyte conductivity-correcting agent, and an amalgamating agent to prevent formation of localized cells or electrolytic pairs on the zinc plate during discharge. An electrolyte suitable to be used in a lead dioxide--zinc rechargeable-type cell comprises an aqueous acid solution of a zinc salt, aluminum sulfate as the zinc surface-controlling agent, sodium sulfate as the electrolyte conductivity-correcting agent, mercuric sulfate as the amalgamating agent, and sulfuric acid as an aggressive agent which also acts to minimize the ''treeing'' of the anodic surfaces. More particularly, an electrolyte to be used in a lead dioxide--zinc rechargeable-type cell comprises from 1 to 5 g/l of zinc sulfate, 25 to 75 g/l of sodium sulfate, 25 to 75 g/l of aluminum sulfate, 2 to 8 g/l of mercuric sulfate, and 250 to 500 g/l sulfuric

acid, the remainder being water. Preferably, the electrolyte may additionally contain 10 to 30 g/l of a suitable gum such as dextrin to improve the physical structure of the zinc deposited, and 5 to 15 g/l of dibutyl amine as a corrosion inhibitor.

864 BATTERY HAVING DEFORMATIONS IN A METAL LAYER. Oltman, J.E.; Feldhake, R.H. (to ESB Inc.). US Patent 3,964,932. 22 Jun 1976. Filed date 14 Aug 1975. 10p.

A plurality of deformations is provided in a metal layer in a battery to avoid wrinkles in that metal layer. The deformations may be situated in that portion of the metal layer which is part of a peripheral sealing system for the battery and/or in that portion of the metal layer inside the peripheral sealing system. The deformations may be oriented along axes which are (a) substantially concentric with the edges of the peripheral sealing system, (b) substantially perpendicular to the edges of the sealing system, or (c) neither (a) or (b). The metal layer may have a pocket indented therein, the indented pocket being situated inside the peripheral sealing system and over the electrodes of the battery. 17 figures.

865 ELECTRICAL ENERGY STORAGE AND INTERCALATION CHEMISTRY. Whittingham, M.S. (Exxon Research and Engineering Co., Linden, NJ). Science; 192: 1126-1127(11 Jun 1976).

The electrochemical reaction of layered titanium disulfide with lithium giving the intercalation compound lithium titanium disulfide is the basis of a new battery system. This reaction occurs very rapidly and in a highly reversible manner at ambient temperatures as a result of structural retention. Titanium disulfide is one of a new generation of solid cathode materials. 2 figures.

866 TRUTH ABOUT NI--CD CELL REVERSAL. Pensabene, S.F. (GE, Gainesville, FL). Mach. Des.; 48: No. 14, 97-99(10 Jun 1976).

Rechargeable nickel--cadmium cells connected in series ideally should have nearly equal energy capacity. Otherwise, under deep discharge on a multicell battery, the first cell to discharge completely could generate gas and, unless equipped with a safety vent, could burst. This phenomenon, called cell reversal, gave earlier completely sealed nickel--cadmium cells a bad reputation. Now, cells produce oxygen during overcharge which penetrates the insulating material to reach the cadmium and convert it back to its uncharged cadmium hydroxide form. Some manufacturers have added a material to both plates that accepts electrons more easily than hydroxyl or water molecules.

867 ELECTROCHEMICAL GENERATOR. Lehmann, G.; Rassinoux, T. (to Saft-Societe des Accumulateurs Fixes et de Traction). US Patent 3,960,595. 1 Jun 1976. Priority date 31 Jan 1972, France. 10p.

This invention relates to high-energy-density electrochemical generators of the alkaline, more particularly lithium, negative-electrode type. An electrolyte whose solvent contains 1--3 dioxane, dioxolane or propylene oxide, preferably mixed with propylene carbonate or ethylene carbonate, is utilized. This electrolyte has excellent conductivity, even at a relatively slight concentration of the solute. Lithium perchlorate is preferred as the solute; and copper oxide, monovalent silver chromate, lead chromate, fluorinated carbons, polymerized fluorinated carbons or mixtures of these latter with metal compounds are preferred as active positive material.

868 METHOD FOR FABRICATING ELECTROCHEMICAL CELLS. Werth, J.; Crouch, D.A.; Sklarchuk, J.C. (to ESB Inc.). US Patent 3,960,597. 1 Jun 1976. Filed date 9 Jun 1975. 10p.

High-temperature secondary cells having a molten salt or fused salt electrolyte are fabricated in ambient atmosphere. Such cells typically have an electrolyte, a positive reactant, or a negative reactant which are capable of reacting with moisture or oxygen contained in the atmosphere. The ingredients or materials comprising the positive and negative reactants and the electrolyte are processed in a state in which they do not react significantly with moisture or oxyten in the ambient atmosphere. Thereafter, they are electrically charged in the positive reactant compartment of a cell container at the operating temperature of the cell, whereby the negative reactant of the cell is provided in the negative reactant compartment of the cell container and a positive reactant--electrolyte melt is provided in the positive reactant compartment of the cell container.

869 PRIMARY OR SECONDARY ELECTROCHEMICAL CELL. Fritz, H.P.; Besenhard, J. (to Rheinisch-Westfalisches Elektrizitatswerk Aktiengesellschaft). US Patent 3,960,594. 1 Jun 1976. Priority date 9 Nov 1972, German, Federal Republic of (F.R. Germany). 6p.

A description is given of a primary or secondary electrochemical cell having a negative electrode consisting of a light metal or an alloy predominantly consisting of a light metal (especially lithium), a nonaqueous aprotic preferably organic electrolyte, and a positive electrode which consists at least predominantly of a metal or metalloid which is capable of electrochemically forming an intermetallic compound with the light metal upon cathodic liberation thereof. The positive electrode may consist of, at least in major part, arsenic, antimony or other semimetal, metalloid or semiconductor.

870 TRACTION BATTERIES AND ELECTRONIC CONTROL MAKING LOW MAINTENANCE DEMANDS. Foerdern Heben; 26: No. 7, 762-764(Jun 1976). (In German).

2 figs..

The report is on newly developed batteries from VARTA AG (Hannover) which have especially low maintenance demands and which have an electronic charging control. The cell containers and lids of the batteries are made of polypropylene, a material which has inferior wall strength but which offers a high degree of durability and good insulation values. The pole socket is welded to the pole and lid so that the cells are electrolytically compact. Clearing of the battery is seldom required. The maintenance interval can be prolonged since corrosion problems no longer occur. Battery systems of this kind are favorably suited for electric-powered conveyance. The batteries are also suitable for an electricity supply system for load-raising magnets, where they can supply the magnet during power shortages until the load has been safety disposed of beyond a certain danger zone.

871 PRESENT SOLUTIONS AND FUTURE PROSPECTS FOR THE POWER SUPPLY OF SELF-CONTAINED TELECOMMUNICATION STATIONS. Desfresnes, J.P. Rev. Gen. Electr.; 85: No. 6, 510-520(Jun

1975). (In French).
The data concerning the delicate problem raised by isolated or remote plants on power distribution networks are recalled and the present conventional solutions, i.e.: cells, batteries, thermoelectric generators, closed-loop operated turbo-generators and generating sets are first considered. New solutions are then discussed. Among them, more particularly, the stress is laid on aerogenerators and photovoltaic (solar) cells. Future prospects open to new solutions and the corresponding pilot developments are considered in conclusion.

872 PRIMARY ELEMENT WITH NEGATIVE ZINC OR MAGNESIUM ELECTRODE AND A POLYETHYLENE GLYCOLETHER AS CORROSION INHIBITOR. Jung, G.; Bauer, J. (to Varta Batterie AG). German(FRG) Patent 2,320,555/C/. 6 May 1976. 3p. (In German).
The invention applies to a primary element with a negative zinc or magnesium electrode, a positive depolarizer electrode and a polyethylene glycolether as corrosion inhibitor.

873 ZINC CHLORINE MOLTEN SALT CELL. vonWinbush, S.; Sammells, A.F. (Gould Inc., St. Paul). J. Electrochem. Soc.; 123: No. 5, 650-653(May 1976).
Preliminary work was done to study the feasibility of a molten zinc chloride cell, using NaCl and KCl additions to increase the electric conductivity. It is concluded that more work is needed to optimize the Zn deposition for good adhesion to the substrate. (DLC)

874 MATERIALS BALANCE IN PRIMARY BATTERIES. III. COMPUTER AIDED DESIGN FOR STANDARD SIZE LITHIUM-THIONYL CHLORIDE HIGH POWER CELLS. Marincic, N.; Koffman, D.B. (GTE Lab. Inc., Waltham, MA). J. Appl. Electrochem.; 6: No. 3, 263-268(May 1976).
Study of the design characteristics of high power type batteries made with the lithium/thionyl chloride system. A computer program flow chart is presented for solving the system of equations correlating all the dimensions of cell components for any selected cell size. Various cell designs are presented for the three standard cell sizes, AA, C and D showing the effect of the geometry of the cell components on the resultant cell capacity. An optimized cell design is suggested for each particular discharge rate required. As a result of the optimization of the electrode structure, a substantial improvement in the maximum cell capacity was obtained with all three cell sizes. 2 refs.

875 GALVANIC ELEMENT WITH NEGATIVE LIGHT METAL ELECTRODE WITH SOLID POSITIVE ELECTRODE AND NONAQUEOUS ELECTROLYTE. Fritz, H.P.; Besenhard, J. (to Rheinisch-Westfaelisches Elektrizitaetswerk A.G., Essen (Germany, F.R.)). German(FRG) Patent 2,450,489/A/. 29 Apr 1975. 15p. (In German).
2 figs. Available from Dt. Patentamt, Muenchen (FRG).
The invention deals with a galvanic element with negative light metal electrode, solid positive electrode and non-aqueous electrolytes with which a reversible electrochemical reaction occurs between the positive electrode and light metal ions of the electrolyte, which consists of light metal salt dissolved in aprotic, polar, organic solvents. Light metal electrode signifies electrodes of light metal or of an alloy mainly consisting of light metal. The electrolyte may also consist of several light metal salts dissolved in aprotic, polar, organic solvents. A primary element or a secondary element may be concerned here.

876 ELECTROCHEMICAL CELLS HAVING A LIQUID ALKALI METAL ELECTRODE AND SOLID ELECTROLYTE. Jones, I.W.; Miles, L.J.; Robinson, G. (to Electricity Council). US Patent 3,953,227. 27 Apr 1976. Priority date 3 Jan 1973, United Kingdom of Great Britain and Northern Ireland (UK). 8p.
In an electrochemical cell, such as a sodium--sulfur cell, having a liquid metal electrode and a solid electrolyte, the solid electrolyte is an upright tube with a closed end, and a reservoir is provided above the top of the electrolyte tube to accommodate the increased volume of the cathodic reactant as the cell discharges. In this way the whole surface of the electrolyte can be in contact with the cathodic reactant despite the increase in volume of the cathodic reactant in the cathodic compartment.

877 SEALED LITHIUM--SULFUR MONOCHLORIDE CELL. Roth, W.L.; Farrington, G.C. (to General Electric Co.). US Patent 3,953,233. 27 Apr 1976. Filed date 19 Mar 1975. 6p.
A sealed lithium--sulfur monochloride cell is described which comprises a casing; an anode positioned within the casing, the anode selected from the class consisting of lithium, lithium as an amalgam, and lithium in a non-aqueous electrolyte; a cathode positioned within the casing, the cathode consisting of sulfur monochloride with an ionic conductivity enhancing material; and a solid lithium--sodium aluminate electrolyte positioned within the casing between the anode and cathode and in contact with both the anode and cathode. The solid lithium--sodium aluminate electrolyte has an approximate composition of $LiNaO.9Al_2O_3$, of which 1.3 to 85 percent of the total alkali ion content is lithium.

878 CURRENT-DRAWING PART OF A GALVANIC ELEMENT AND METHOD FOR ITS PRODUCTION. Sprengel, D.; Jung, M. (to Varta A.G., Hannover (F.R. Germany)). German(FRG) Patent 2,237,656/C/. 22 Apr 1976. 2p. (In German).
A galvanic element is described whose current-drawing parts of copper are safely protected by a copper-amalgam layer from corrosion.

879 MODULAR ELECTRICAL ENERGY STORAGE DEVICE. Saunders, R.C. (to Electric Power Research Inst.). US Patent Application B512,818. 6 Apr 1975. Filed date 7 Oct 1974. 14p.
A compact modular electrical energy storage device comprises one or more cell modules in which certain components of the device are maintained in a substantially fixed position by utilizing a resilient porous body of compressed carbon fibers to urge the components into physical contact with one another. The invention further provides means for maintaining the cell components in such fixed position during cell operation at elevated temperatures for extended periods of time. A preferred compact cell module construction particularly suitable for use in a high-temperature, high-energy-density lithium battery includes two positive electrode assemblies positioned in opposing relationship by a U-shaped spacer member maintained in contact with a separator member of each

positive electrode assembly by a resilient porous body of compressed graphite fibers, a unitary double-faced negative electrode assembly being positioned between the two positive electrode assemblies. 6 figures.

880 AUTOMOTIVE BATTERIES. Givens, L. Automot. Eng. (N.Y.); 84: No. 4, 33-39(Apr 1976).

The author presents a historical review of automotive battery design and manufacture which concludes with an examination of modern battery manufacturing methods and materials.

881 ELECTROCHEMICAL CELL ASSEMBLED IN DISCHARGED STATE. Yao, N.P.; Walsh, W.J. (to Energy Research and Development Administration). US Patent 3,947,291. 30 Mar 1976. Filed date 30 Sep 1974. 12p. PAT-APPL-510,840.

A secondary electrochemical cell is assembled in a completely discharged state within a sealed containment. As assembled, the cell includes a positive electrode separated from a negative electrode by a molten salt electrolyte. The positive electrode is contained within a porous structure, permitting passage of molten electrolyte, and includes one or more layers of a metallic mesh, e.g. iron, impregnated with an intimate mixture of lithium sulfide and the electrolyte. The negative electrode is a porous plaque of aluminum metal. Prior to using the cell, an electrical charge forms lithium--aluminum alloy within the negative electrode and metal sulfide within the positive electrode. 2 tables, 14 figures.

882 SMALL UPS: THE BATTERY VIEW. Evjen, J.; Bridgers, R. (GE, Gainesville, Fla). Control Eng.; 23: No. 3, 43-44(Mar 1976).

The uninterruptibile power supply (UPS), whether used to maintain a RAM memory for extended periods of time or power a complete process for brief blackouts, can help eliminate many problems of electrical/electronic control systems caused by blackouts, brownouts, or transients in power lines. An essential component of the UPS, the battery, often gets lost in the wake of the discussion of electronic portion of UPS's, or uninterruptible power supplies. The article discusses properties and features of various batteries.

883 DEEP SEA PRESSURE COMPENSATED EXPENDABLE ENERGY SOURCE. Waltz, A.R. (to Secretary of the Navy). US Patent 3,940,286. 24 Feb 1976. Filed date 13 Jun 1975. 6p.

An improved power source for marine applications includes a salt water-activated battery adapted for actuation after a specific, predetermined immersion time. The improved battery construction is characterized by an enclosed volume of flexible, plastic material confining the seawater electrodes. The pair of panel-like closures seal apertures in the top and bottom surface of the battery case to confine an inert liquid. A retention mechanism holds the panel-like closures in the sealed position against an actuation system which urges the panels in an open position.

884 RECOVERY OF LEAD FROM BATTERY SCRAP. Wilson, D.A. (to Dept. of the Interior). US Patent 3,940,265. 24 Feb 1976. Filed date 25 Jun 1975. 4p.

Lead is recovered from battery scrap by means of a process comprising reacting the scrap with a slurry of calcium hydroxide to form a product comprising PbO and $CaSO_4 2H_2O$, filtering and drying the reaction product, and reacting the product with a mixture of carbon and a KCl--NaCl flux at elevated temperature to flux the calcium sulfate and reduce the lead oxide to metallic lead.

885 SODIUM SULFUR CELLS. Sudworth, J.L. (to British Railways Board). US Patent 3,939,007. 17 Feb 1976. Priority date 16 Jan 1973, United Kingdom of Great Britain and Northern Ireland (UK). 4p.

A sodium--sulfur cell comprises inner and outer tubes, the inner tube constituting the solid electrolyte for the cell. The interior of the inner tube defines the anode compartment of the cell, and the space between the inner and outer tubes defines the cathode compartment of the cell. The inner tube contains metal wool and/or a plate spaced from the inner surface of the inner tube to cause molten sodium to be distributed over the inner surface of the inner tube by capillary action. The inner and outer tubular members are closed at one end by a compression seal assembly. The seal assembly comprises a flange on the inner tubular member engaging the end of the outer tubular member to close the end of the outer tubular member, a closure member engaging the flange to close the inner tubular member, and a clamp fitting over the closure member and held in position by the outer tubular member.

886 BATTERY WITH RECESSED TERMINALS AND FUSE. Slautterback, R.C. (to Eltra Corp.). US Patent 3,937,636. 10 Feb 1976. Filed date 12 Jun 1975. 6p.

A wet cell battery has a plurality of covered recesses in the top. Positive and negative terminals extend into two of the recesses. A two-conductor cable which extends out of the recesses is connected to the terminals and includes a fuse which is disposed in one of the recesses. 10 figures.

887 BATTERY-DRIVEN MOTOR ARRANGEMENT. Mabuchi, K. (to Mabuchi Motor Co. Ltd). German(FRG) Patent 2,529,227/A/. 15 Jan 1976. 12p. (In German).

2 figs. Available from Dt. Patentamt, Muenchen (FRG).

Hydrogen can escape from nickel--cadmium batteries. If they are used in conventional battery operated motor arrangements, there is then a danger of oxyhydrogen gas explosions if the hydrogen penetrates into spaces in which oxyhydrogen gas can be ignited by switch-on and switch-off arcs of electrical contacts or motor brushes. The present invention removes this danger by suitable construction of the battery--motor casing and the contacts.

888 THIN-FILM GALVANIC CELL $PB/PBF_2/PBF_2,CUF_2/CU$. Kennedy, J.H.; Hunter, J.C. (Univ. of California, Santa Barbara). J. Electrochem. Soc.; 123: No. 1, 10-14(Jan 1976).

Thin-film solid-state galvanic cells were fabricated using Pb metal as anode, $PbF_2$ as electrolyte, and $CuF_2$ as cathode. Because of the high resistivity of $CuF_2$, it was codeposited with $PbF_2$ to form a more conductive mixed cathode layer. Such cells developed open-circuit voltages from 0.61 to 0.70 V, compared to 0.70 V theoretical. Cells were discharged at room temperature. At elevated temperatures the current densities attainable were considerably higher. Cells discharged under constant load exhibited relatively constant voltage during discharge and a sudden drop-off at the end of discharge. Cathode utilization for the cathode-limited cells was typically 30 to 40%. Attempts

to recharge these cells were unsuccessful.

889 MATERIALS BALANCE IN PRIMARY BATTERIES. II. LITHIUM INORGANIC BATTERIES AT HIGH DISCHARGE RATES. Marincic, N. (GTE Lab. Inc., Waltham, MA). J. Appl. Electrochem.; 6: No. 1, 51-58(Jan 1976).

A study was continued of the design characteristics and optimization procedures leading to an improvement of the maximum cell capacity obtainable with high power type lithium inorganic batteries. The general relations derived for the low power type cells have been modified for use in the design of the high power type cells. A materials balance was established for the interior components of cylindrical cells made for high discharge rates. Design parameters were calculated using a computer program for several sizes of cylindrical cells. A satisfactory agreement was reached between the predicted and the realized performance of the cells built with the calculated design parameters.

890 BATTERIES FOR ENERGY STORAGE. Douglas, D.L. (Gould Labs., Chicago). Am. Chem. Soc., Div. Fuel Chem., Prepr.; 19: No. 4, 135-154(1975).

From 168. national meeting of American Chemical Society; Atlantic City, New Jersey, USA (8 Sep 1974).

See CONF-740955--P1.

The oncoming requirement for storing off-peak generated electricity for use during periods of peak demand will offer a major challenge to the battery industry. The reliability and cost objectives, which will be difficult to achieve, are a life of eight years (2500 cycles) and $20 per kWh, respectively. Lead--acid batteries, the exemplar of today's battery technology, may meet the reliability requirements, but may be too costly for all but special situations. Advanced battery technology in several manifestations is just now making the transition from the research phase to development of multikilowatt experimental units. The electrochemical systems under development include sodium--sulfur, lithium--sulfur, aluminum--chlorine and zinc--chlorine. The first two suffer materials problems incident to handling corrosive agents at elevated temperature. Little public disclosure has been made relative to the aluminum--chlorine system. The zinc--chlorine battery, storing chlorine as the hydrate, has the advantage of operating near room temperature. A number of formidable technical hurdles remain to be surmounted by each of the new battery systems. An operating installation in the megawatt-hour range is not expected before the early 1980's.

891 ENGINEERING THE SILVER--ZINC BATTERY FOR THE DEEP SUBMERGENCE RESCUE VEHICLE. Briggs, W.B.; Wilson, J.V.; Inouye, A.I.; Tucker, L.W. (Naval Civil Engineering Lab., Port Hueneme, CA). pp 447-451 of Eleventh intersociety energy conversion engineering conference. Vol. I. New York; American Institute of Chemical Engineers (1976).

From 11. intersociety energy conversion engineering conference; State Line, Nevada, USA (12 Sep 1976).

See CONF-760906--P1.

The high energy density and general compatibility with hyperbaric environments of silver--zinc batteries have made them a good choice for use as a power supply for the Deep Submergence Rescue Vehicle (DSRV). In practice, however, these oil-filled, pressure-compensated batteries have had a history of persistent low resistances to ground and high maintenance requirements because of the potassium hydroxide electrolyte (KOH) carried out of the cells by evolved hydrogen. Additionally, there has been no satisfactory method to determine and predict the battery capacity during the multi-dive, rapid-turnaround missions required of the DSRV. The lack of prediction capability has caused loss of power in potentially critical situations. The grounding problem was attacked in four separate ways: retaining the electrolyte in the cell through more efficient gas/liquid separation at the cell top; the development of individually insulated and removable bus bars; the installation of "drip pans" to catch electrolyte spillage; and the selection of proper materials to eliminate metal penetration through the fiberglass battery box and use materials that are non-wetting with KOH wherever possible. In addition, a method for predicting battery capacities during operational situations was developed at CEL. The method is dependent upon several charge acceptance and efficiency factors, which are being determined experimentally. The prediction method was applied accurately in laboratory tests.

892 DEVELOPMENT OF UNCHARGED LI--AL/FES/SUB X/ CELLS. Shimotake, H.; Walsh, W.J.; Carr, E.S.; Bartholme, L.G. (Argonne National Lab., IL). pp 471-476 of Eleventh intersociety energy conversion engineering conference. Vol. I. New York; American Institute of Chemical Engineers (1976).

From 11. intersociety energy conversion engineering conference; State Line, Nevada, USA (12 Sep 1976).

See CONF-760906--P1.

Li--Al/FeS/sub x/ cells which were assembled in an uncharged state have been tested with highly promising results. These cells experienced neither significant shape change nor gassing after operating over 4000 h. The electrical performance of the uncharged cells was equal to or greater than the performance of equivalent charged Li--Al/FeS/sub x/ cells. The fabrication and assembly of both negative and positive electrodes were greatly simplified over previous methods. The cell designs, electrode development, and assembly procedures are summarized along with the electrical performance results. 8 figures, 2 tables.

893 DEVELOPMENT STATUS OF LITHIUM--SILICON--IRON SULFIDE LOAD-LEVELING BATTERIES. McCoy, L.R.; Heredy, L.A. (Atomics International Div., Canoga Park, CA). pp 485-490 of Eleventh intersociety energy conversion engineering conference. Vol. I. New York; American Institute of Chemical Engineers (1976).

From 11. intersociety energy conversion engineering conference; State Line, Nevada, USA (12 Sep 1976).

See CONF-760906--P1.

A program for the development of lithium--silicon--iron sulfide batteries for electric utility load leveling is being conducted at Atomics International. These batteries use a molten LiCl--KCl electrolyte, and are operated at a temperature of 400°C or higher. The lithium--silicon alloy, $Li_5Si$, is used as the active material in the negative electrodes. Positive electrodes contain the iron sulfides, FeS, $FeS_2$, or their mixture. Electrode development tasks are concerned with minimizing the weight and cost of supporting structures and optimizing electrode performance. Porous ceramic separators, based upon rigid structural materials, are being developed. Cell development is being conducted through scale-up

stages involving increasing electrode area and numbers of parallel-connected electrodes to reach a full-size modular cell. A status review of this effort is presented. 9 figures, 1 table.

894 DEVELOPMENT OF COMPACT LITHIUM/IRON DISULFIDE ELECTROCHEMICAL CELLS. Dunning, J.S.; Bradley, T.G.; Zeitner, E.J. (General Motors Corp., Warren, MI). pp 491-496 of Eleventh intersociety energy conversion engineering conference. Vol. I. New York; American Institute of Chemical Engineers (1976).

From 11. intersociety energy conversion engineering conference; State Line, Nevada, USA (12 Sep 1976).

See CONF-760906--P1.

The design and testing of two compact Li alloy/F $S_2$ cells are discussed. These cells operated at 425°C to 500°C, and delivered up to 130 Wh/kg and 59 W/kg during separate cycles. The best performance was obtained by using an 80 a/o lithium--silicon negative electrode in a cell weighing 823 g and having a capacity of about 80 Ah. This cell operated for 1700 h and 77 cycles. The other cell, using a lithium--aluminum alloy negative electrode, is still operating after 7800 h and 445 cycles. Reference electrodes were used to determine the voltage traces of each electrode during charge and discharge. Voltage plateaus were correlated with specific regions of the phase diagram of the negative electrodes and the reaction mechanism of the positive electrodes. Improvement of performance in critical problem areas is also discussed. 6 figures, 3 tables.

895 DEVELOPMENT OF SODIUM/SULFUR - CELLS. Bauer, R.; Fischer, W.; Haar, W.; Kleinschmager, H.; Langpape, R.; Weddigen, G. (Brown, Boveri and Cie AG, Heidelberg). pp 497-502 of Eleventh intersociety energy conversion engineering conference. Vol. I. New York; American Institute of Chemical Engineers (1976).

From 11. intersociety energy conversion engineering conference; State Line, Nevada, USA (12 Sep 1976).

See CONF-760906--P1.

The state of the development of Na/S cells at Brown Boveri is described. The solid electrolyte used is magnesia-doped β-alumina having an electrical conductivity of 0.2 to 0.3 $(\Omega \cdot cm)^{-1}$ at 300°C. In Na/Na cells tubular electrolytes have attained lifetimes of more than 3,500 Ah/$cm^2$. After preliminary corrosion tests stainless steels look promising as container materials. Several refractory materials exhibited nearly no corrosion in $Na_2S_4$. Two types of Na/S cells having glass and stainless steel containers are used for laboratory tests. Their effective capacity, which is usually limited to about 40 percent of the theoretical value, can be increased by several means, but the stability of performance has still to be improved. 5 figures, 2 tables.

896 SODIUM/SULFUR BATTERY DEVELOPMENT IN THE UNITED KINGDOM. Dell, R.M. (Atomic Energy Research Establishment, Harwell, Eng.); Sudworth, J.L.; Jones, I.W. pp 503-509 of Eleventh intersociety energy conversion engineering conference. Vol. I. New York; American Institute of Chemical Engineers (1976).

From 11. intersociety energy conversion engineering conference; State Line, Nevada, USA (12 Sep 1976).

See CONF-760906--P1.

Recent progress in a co-ordinated research and development program on sodium sulfur batteries in the United Kingdom is described. A central sulfur cell design was adopted which circumvents the long-standing problem of case corrosion in conventional tubular designs by placing the sulfur electrode inside an electrolyte tube. The design is particularly suited to high-rate motive power applications, and over 85 percent utilization of the sodium and sulfur active materials was achieved with experimental electrode constructions. 6 figures.

897 NICKEL--HYDROGEN STORAGE BATTERY FOR USE ON NAVIGATION TECHNOLOGY SATELLITE-2. Betz, F. (Naval Research Lab., Washington, DC); Stockel, J.; Gaudet, A. pp 510-516 of Eleventh intersociety energy conversion engineering conference. Vol. I. New York; American Institute of Chemical Engineers (1976).

From 11. intersociety energy conversion engineering conference; State Line, Nevada, USA (12 Sep 1976).

See CONF-760906--P1.

Naval Research Laboratory (NRL) and INTELSAT have entered into an agreement to flight test a nickel--hydrogen battery. INTELSAT is providing the nickel--hydrogen cells, NRL is integrating these cells into the spacecraft energy storage system, and A. D. Little is performing the spacecraft thermal analysis. This paper presents a description of the nickel--hydrogen cells. Design features include electrochemically impregnated positive electrodes, asbestos separators, and teflon-backed platinum negative electrodes. The flight mission plan is to use the nickel--hydrogen battery as the prime power source during eclipse periods in a medium-altitude satellite with a 3-year minimum life. The mission requires full load operation of approximately 325 W through all eclipses. The thermal design objective was to maintain the battery temperature between 0°C and 24°C during normal operation. Results of thermal vacuum testing have verified the design objectives and the use of temperature for charge control. 10 figures, 1 table.

898 ADVANCED SEALED NICKEL--CADMIUM CELL DESIGN. Miller, L.E. (Eagle-Picher Industries, Inc., Joplin, MO). pp 528-531 of Eleventh intersociety energy conversion engineering conference. Vol. I. New York; American Institute of Chemical Engineers (1976).

From 11. intersociety energy conversion engineering conference; State Line, Nevada, USA (12 Sep 1976).

See CONF-760906--P1.

Incorporating the superior gas recombination design provisions of the nickel--hydrogen system, an advanced sealed nickel--cadmium cell design evolved which offers improved performance characteristics. The advanced design permits utilization of high-stability inorganic separator materials, recombination of both oxygen and hydrogen gas on overcharge, and operation with high levels of electrolyte. 4 figures, 1 table.

899 HIGH PERFORMANCE ELECTRIC COMMERCIAL VEHICLES FOR CITY USE. Harding, G.G. SAE Prepr.; No. 760073, 1-13(1976).

Lucas Industries Limited commissioned work on electric vehicles some seven years ago in order to provide test beds for batteries which were under development. During the past three years the battery development work has been concentrated on lightweight lead--acid

batteries, and work on the vehicles themselves has been stepped up. A comprehensive electric vehicle development program is now being undertaken. During the last 18 months this has led to the production of fifteen 1 ton payload vans, a personnel carrier, a 34-passenger city bus and two city taxis. All these vehicles will be used by operators in service for extended periods in order that they can be evaluated from operational, engineering and financial points of view.

900 DRY BATTERIES. MODERN ENERGY SOURCES WITH AN EVER BROADER RANGE OF APPLICATIONS. Elektro-Handel; 21: No. 4, 217-220(1976). (In German).

The demand for dry batteries, continuously rising during the last few years, can be explained, on the one hand, by the low degree of power consumption of modern electric devices, and on the other hand, by essential improvements in construction and in primary elements. The construction properties of these primary elements (round cells, flat cells, button cells) are described and load figures are given. The advantages of alkaline manganese dioxide--zinc batteries operating with an alkaline electrolyte are pointed out.

901 ZINC--BROMIDE SECONDARY CELL. Leddy, J.J.; Gritzner, G. (to Dow Chemical Co.). US Patent 3,929,506. 30 Dec 1975. Filed date 18 May 1973. 8p.

A zinc-bromine secondary cell is divided into two compartments by an ion exchange diaphragm. The electrolyte system includes an essentially bromide-ion-free, aqueous solution containing a zinc ion as an anolyte and a bromide ion containing catholyte. A method of operating the cell is disclosed. 2 figures, 2 tables. (auth)

902 RECHARGEABLE POWER SOURCE. Gore, J.S.; Walk, C.R. (to Honeywell Inc.). US Patent 3,929,504. 30 Dec 1975. Filed date 18 Dec 1974. 4p.

A new power source capable of operating in a discharge mode and in a charge mode is described which includes a lithium anode, a vanadium pentoxide cathode, and an electrolyte including lithium perchlorate dissolved in propylene carbonate. Also included is a means for enclosing one of the electrodes with a permeable material to permit passage of electrolyte ions and yet prevent passage of larger lithium metal formed during operation in the charge mode. 1 figure, 2 tables (auth)

903 ELECTROCHEMICAL CELL. Auborn, J.J.; Lieberman, S.I. (to GTE Labs., Inc.). US Patent 3,923,543. 2 Dec 1975. Filed date 24 Oct 1974. 14p.

An electrochemical cell is described which has an alkali metal anode; a cathode including as the active cathode material an intercalation compound of graphite and fluorine of the general formula $(C_4F)_n$, wherein n refers to the presence of a large, but indefinite, number of recurring $(C_4F)$ groups in the intercalation compound; and an electrolyte containing an inorganic solvent selected from the group consisting of phosphorus oxychloride, monofluorophosphoryl dichloride, thionyl chloride, sulfuryl chloride, and mixtures thereof, and a solute dissolved in the inorganic solvent material. Of particular interest are those cells which have a Lewis acid, or an excess of a Lewis acid, present in the electrolyte either by actual addition or by dissociation. A unique feature of such cells is that the cathode material will catalyze the electrochemical decomposition of the solvent resulting, quite unexpectedly, in a cell having a coulombic cathode utilization efficiency greater than 100 percent of the theoretical attainable according to reduction of the active cathode material.

904 (N--76-14611) DISCHARGE DATA OF LEAD BATTERIES AND THEIR INFLUENCE ON THE OPTIMIZATION OF THE STORAGE CAPACITY OF ELECTRICAL VEHICLES. Runge, W. Transl. Into English from Elektrotech. Z., Ausgabe (West Ger.), V. 94, No. 2, Feb. 1973 p 83-86. (Dec 1975). 12p. (NASA-TT-F--16821). NTIS $3.50.

A generalized analytical expression is found for the useful capacity and average discharge voltage as a function of the discharge current of a lead accumulator. The temperature influence is taken into account. From this it is possible to establish a relationship between the energy which can be drawn off and the power level at which the accumulator is loaded. It is found that the optimum of the storage unit fraction at which the product of range and remaining payload of the vehicle becomes a maximum depends practically only on two parameters. These are the empty mass fraction of the vehicle without the storage unit and the discharge parameter which describes the capacity decrease when the discharge current is increased. (Author) (GRA)

905 RECENT DEVELOPMENTS IN BATTERY TECHNOLOGY. Jones, W.R. (Chloride Tech. Ltd, Manchester, Eng.). Electron. Power; 21: No. 20, 1118-1121(27 Nov 1975).

Although the lead--acid cell still reigns over all other batteries in the electric-propulsion field, much effort is being directed to developing batteries using so-called exotic couples such as sodium--sulfur, which will give a weight advantage over the lead--acid battery and an increased range of vehicle operation.

906 RECENT DEVELOPMENTS IN BATTERY TECHNOLOGY. Jones, W.R. (Chloride Tech Ltd, Manchester, Eng.). Electron. Power; 21: No. 20, 1118-1121(27 Nov 1975).

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907 ELECTROCHEMICAL CELLS HAVING A LIQUID ALKALI METAL ELECTRODE. Robinson, G.; Jones, I.W. (to Electricity Council). US Patent 3,922,176. 25 Nov 1975. Priority date 3 Jan 1973, United Kingdom of Great Britain and Northern Ireland (UK). 6p.

In an electrochemical cell, such as a sodium--sulfur cell, having a liquid metal electrode and a solid electrolyte, capillary means are provided to draw the liquid metal over one face of the electrolyte, so enabling the whole surface of the electrolyte to be in contact with the metal despite reduction in volume of the metal in the anodic compartment. The capillary means may be constituted by a narrow space between the electrolyte and another member, e.g., a housing, or by fibrous or porous material forming a wick. 9 figures. (auth)

908 PLURAL CELL BATTERY. Granqvist, C.E.

(to Aktiebolaget Tudor). US Patent 3,922,175. 25 Nov 1975. Priority date 14 Dec 1970, Sweden. 8p.

A plural-cell battery composed of a plurality of cells (primary or secondary) is described wherein the electrodes in adjacent cells are rod-shaped comprising a core of a plastic insulating material surrounded by active material in which several electrical leads of conductive material are imbedded. Electrodes of this type may be interconnected by conducting lines which are arranged to pass straight through the common wall between adjacent cells, or may be connected at one end to a pole bridge and thereby form a tubular plate electrode. 10 figures. (auth)

909 DIVALENT SILVER OXIDE-ZINC CELL HAVING A UNIPOTENTIAL DISCHARGE LEVEL. Kozawa, A. (to Union Carbide Corp.). US Patent 3,920,478. 18 Nov 1975. Filed date 25 Jun 1974. 10p.

An alkaline silver oxide--zinc cell is described which has a negative electrode, an alkaline electrolyte, a positive electrode comprising divalent silver oxide housed in a positive terminal container, and a separator disposed between the negative electrode and the positive electrode. A discontinuous oxidizable metal, such as a zinc screen, is interposed between the positive electrode and the inner wall of the positive terminal and/or between the positive electrode and the separator so as to achieve a unipotential discharge level on low-drain conditions. 7 figures. (auth)

910 SODIUM--HALOGEN BATTERY. Hess, H.J. (to General Electric Co.). US Patent 3,918,991. 11 Nov 1975. Filed date 20 Sep 1974. 6p.

A sodium--halogen battery is disclosed which comprises a casing, an anode positioned in the casing, a solid sodium ion-conductive electrolyte adjacent to the anode, and a cathode positioned adjacent to the opposite side of the solid electrolyte. The anode consists of sodium in a nonaqueous organic electrolyte of pure 1,2-dimethoxyethane containing a dissolved sodium salt, the salt being selected from the class consisting of sodium perchlorate and sodium bromide. 1 figure, 1 table (auth)

911 MATERIALS BALANCE IN PRIMARY BATTERIES. I. LITHIUM INORGANIC CELLS AT LOW DISCHARGE RATES. Marincic, N. (GTE Lab., Inc., Waltham, MA). J. Appl. Electrochem.; 5: No. 4, 313-318(Nov 1975).

A study has been made of the design characteristics and optimization procedures leading to an improvement in the maximum cell capacity obtainable with standard size lithium cells at low discharge rates. General relations have been derived between the cell capacity and the porosity of carbon cathode structures at various stages of cell discharge, based on a cell reaction mechanism proposed earlier. A total materials balance relation has been established for the components involved in the cell reaction in cylindrical cells made for a long range application. Design calculations have been carried out for a typical standard size cylindrical cell. A satisfactory agreement has been achieved between the predicted and the realized performance of cells built according to these calculations.

912 PROCESS FOR MANUFACTURING STORAGE BATTERIES AND BATTERY PRODUCED THEREBY. Sanekata, N.; Hamada, O. (to Yuasa Battery Company Ltd.). US Patent 3,915,751. 28 Oct 1975. Filed date 8 May 1973. 6p.

This invention relates to a process for manufacturing storage batteries and the batteries produced by such process. The process comprisss the steps of inserting anode and cathode plates into a container; inverting the container and embedding the projecting lugs of the anode and cathode plates in a sealing agent disposed in concavities in a cover for the container; sealing the cover on the container; removing respective portions of the cover after the solidification of the sealing agent to present thereby a plurality of cavities, each of which exposes the lugs of corresponding anode plates and cathode plates of adjacent cells to be interconnected; forming connectors for the lugs by filling each cavity with a molten conductive material and allowing the molten material to solidify; and coating the connectors with an insulator. The present invention presents a process which is easily adapted for mass production of inexpensive storage batteries which perform favorably. 4 figures (auth)

913 SODIUM--SULFUR CELL WITH IMPROVED SEPARATOR. Kogiso, T.; Hayashi, H. (to Kabushiki Kaisha Toyota Chuo). US Patent 3,915,741. 28 Oct 1975. Priority data 30 Jul 1973, Japan. 10p.

A sodium--sulfur cell having improved safety features and a high level of performance is described. It embodies a solid electrolyte separator with a plurality of elongated small holes extending side by side through the separator in parallel with the major surfaces of the separator. The separator has at least one passage formed therein to function as a reservoir for delivering molten sodium to the elongated holes.

914 ELECTRIC BATTERY. DeRossi, M. (to Consiglio Nazionalle delle Ricerche). US Patent 3,915,744. 28 Oct 1975. Priority data 31 Aug 1971, Switzerland. 12p.

An electric battery is disclosed which comprises a plurality of cells arranged in series. Each cell comprises an aqueous electrolyte of zinc bromide circulated through the cells during charging and discharging, a bipolar electrode having a zinc anode deposited on one side and bromine cathode and active cathodic mass on the other side. The active cathodic mass contains an active cathodic substance which is substantially insoluble in water and which is capable of combining with cathodic bromine to form solid addition products. Additive substances are dissolved in the electrolyte to reduce the solubility of the active cathodic substance, to increase the conductivity and acidity of the electrolyte, and to encourage the zinc to deposit in a thin and uniform layer. 7 figures, 1 table (auth)

915 SYSTEM AND METHOD FOR OPERATION OF A METAL--AIR SECONDARY BATTERY. Ikeda, H.; Inaba, M.; Ide, M. (to Agency of Industrial Science and Technology). US Patent 3,915,745. 28 Oct 1975. Priority data 9 Dec 1972, Japan. 10p.

The present invention comprises a system for and method of operation of a metal--air secondary battery of an electrolyte circulation type. It comprises a charging circulation system including an electrolyte tank with a large capacity, detachably connectable by a pair of pipe connectors to the apparatus, and a discharging circulation system with a small capacity, these two circulation systems being alternatively changed over by means of a two-

circuit, three-way cock. In a charging mode, the body of a metal--air secondary battery is connected to said tank, which is usually installed in a charging station, so that an active metal may be efficiently electrodeposited by using an ordinary circulation method. In a discharging mode, the tank is detached and the battery is connected to the discharging circulation system so that a minimum quantity of electrolyte, necessary for discharging, may be circulated. The system of the present invention is advantageous, therefore, in that the weight and capacity size of a power supply are reduced by half as compared with those of conventional systems, with the result of an improved ratio of energy to weight and size, and is extremely useful when used in a vehicle-borne metal--air battery, for example, an air--zinc battery for an electric automobile. 9 figures (auth)

916 APPARATUS AND METHOD FOR CONNECTING CELLS OF A BATTERY WITH FORCED CIRCULATION. Pompon, J.P. (to Compagnie Generale d'Electricite). German(FRG) Patent 2,514,610. 23 Oct 1975. Priority date 5 Apr 1974, France. 10p.

These series-connected cells with forced electrolyte circulation have negative electrodes the inner surfaces of which are covered with insulating layers to lower short-circuit current losses. The design is applicable to, for instance, Zn/air batteries. (RWR)

917 THERMAL BATTERY. Baldwin, A.R.; Reinhardt, T.A. (to U.S. Energy Research and Development Administration). US Patent 3,914,133. 21 Oct 1975. Filed date 17 Apr 1973. 4p.

PAT-APPL-351,926.

An improved thermal battery which includes a depression at the interface of electrolyte pellet and anode for trapping of molten material between them is described. 5 figures. (auth)

918 METHODS FOR MOUNTING BATTERY PLATES. Sabatino, A. (to Gould, Inc.). US Patent 3,912,544. 14 Oct 1975. Filed date 12 Nov 1969. 4p.

Battery plates are mounted and aligned in jigs, dipped into a solder bath, and then held in a mold while a lead strap or connecting bracket is cast therein and fused to the plates in one operation. When the lead solidifies, the battery plates are firmly attached thereto. One variation involves dipping the plates in a flux solution before they are dipped in the solder bath. Other variations include subjecting the solder bath or the flux solution to ultrasonic vibrations to enhance the tinning or washing action. 6 figures (auth)

919 FLAT ALKALINE BATTERIES. Beatty, T.R.; Vourlis, H. (to Union Carbide Corp.). German(FRG) Patent 2,514,124. 2 Oct 1975. Filed date 1 Apr 1974. 49p.

ELECTRIC BATTERIES;HYDROXIDES;FABRICATION; CONTAINERS;PLASTICS

920 VIBRATION-PROOF BATTERY. Kosuge, T.; Sano, I. (to Furukawa Denchi Kabushiki Kaisha). US Patent 3,909,294. 30 Sep 1975. Filed date 1 Mar 1973. 4p.

A vibration-proof battery of the type including an electrode plate group holding member adapted to compress from above and electrode plate group positioned on a rest and contained in a battery casing is described. The holding member is formed so as to have along its lower edge comb teeth-shaped projections, and is arranged so that each of the projections compresses the upper edge of a corresponding one of positive and negative electrode plates constituting the electrode plate group. 2 figures (auth)

921 LITHIUM--CHLORINE BATTERY DESIGN. Zeitner, E.J. Jr.; Kennedy, J.H. (to Secretary of the Navy). US Patent 3,909,297. 30 Sep 1975. Filed date 10 May 1968. 8p.

A lithium--chlorine fuel cell is described which has a porous graphite cathode through which gaseous chlorine is diffused into an electrolyte-containing reaction chamber and a molten lithium-wettable metallic fibrous matrix anode which is capable of delivering molten lithium to the reaction chamber. A method for activating the fuel cell is presented. A battery having at least one of the fuel cells attached in series is discussed. 2 figures (auth)

922 ALKALINE CELL. Tsychida, T.; Shinoda, K.; Yasuda, T.; Takeshima, T. (to Fuji Electrochemical Co., Ltd.). US Patent 3,909,295. 30 Sep 1975. Filed date 17 May 1974. 4p.

Leakage of the alkaline electrolyte from this battery is prevented by placing an acid layer at the inner surface of the anode terminal. The acid used is one, either organic or inorganic, which neutralizes the electrolyte. When electrolyte creeps to the terminal by electrocapillary action, it is neutralized by the acid layer. Cells may be stored for a year under reasonable conditions without leakage. (RWR)

923 ALKALINE NICKEL--CADMIUM ACCUMULATOR BATTERY. Tsygankov, M.S.; Kosholkin, V.N.; Bityutskaya, N.A.; Malandin, O.G. USSR Patent 486,406. 30 Sep 1975. Filed date 22 Jun 1973. 9p. (In Russian).

Powder-metallurgy cathodes and coated anodes are used in this Ni/Cd battery. (RWR)

924 BATTERIES COMPRISING VENTED ELECTRODES. Carr, P. (to Energy Development Associates). US Patent 3,909,298. 30 Sep 1975. Filed date 18 Nov 1971. 7p.

A high-energy density battery is described. The bipolar electrodes are constituted of walls of impervious material, preferably graphite. On the outside of the wall is a highly electropositive metal such as zinc; on the inside is a porous electrode of carbon (preferably). The electrodes of a cell constitute the opposite-facing electrodes on adjoining impervious walls. During charging, zinc is deposited on the impervious wall, as by plating from a zinc chloride electrolyte, and simultaneously chlorine is generated at the anode. During operation, zinc chloride solution containing dissolved chlorine is passed through the cell; $Zn \rightarrow Zn$ ion and $Cl \rightarrow Cl^-$. The electrolyte is then re-enriched and recirculated. Holes drilled in the upper part of the electrolyte channels permit venting of trapped gas. (RWR)

925 STORAGE CELL WITH DISSOLUBLE NEGATIVE LINE ELECTRODES. Kocherginskii, M.D.; Kalachev, L.; Naumenko, A.; Penkova, L.F. US Patent 3,907,603. 23 Sep 1975. Filed date 15 Aug 1973. 8p.

A storage cell is described which comprises an electrolyte-filled jar in which are disposed

dissoluble zinc electrodes and positive electrodes fabricated from oxides of nickel or silver or air-depolarized electrodes, with perforated separators disposed between them. The dissoluble zinc electrodes and positive electrodes are provided with current collectors, the current collectors of the dissoluble zinc electrodes being connected to a means for imparting vibration to the zinc dissoluble electrodes in a manner ensuring mechanical interaction between the whole surface of the dissoluble zinc electrodes and the plastic separators and compaction of the sponge-zinc deposit forming on the electrodes in the course of charging. To provide intensive stirring and accelerate the dissolution of the zinc oxide deposit accumulating on the bottom of the jar in the course of discharging, the ends of the zinc electrodes adjacent to the bottom of the jar are bent at a certain angle or connected in pairs by a perforated plate. The dissoluble zinc electrodes consist of at least two layers, the layer adjacent to the plastic separator having a lesser porosity, while the means for imparting vibration to the dissoluble zinc electrodes is a cam drive. (auth)

926 STORAGE CELL WITH DISSOLUBLE NEGATIVE LINE ELECTRODES. Kocherginskii, M.D.; Kalachev, S.L.; Naumenko, V.A.; Pen'kova, L.F. US Patent 3,907,603. 23 Sep 1975. Filed date 16 Dec 1970. 8p.

The battery described consists of Zn anodes, perforated separators, and cathodes of Ni or Ag oxides or air-depolarized electrodes in an electrolyte-filled jar. The Zn anodes can be vibrated to compact the deposit of spongy Zn formed during charging. The battery is designed in such a way that the zinc oxide-containing deposit at the bottom of the battery can be stirred to promote its solution. (RWR)

927 SODIUM--SULFUR BATTERY. Partridge, B.A.; Jankins, T.R.; McGuire, M. (to United Kingdom Secretary of State for Industry, London). German(FRG) Patent 2,509,982. 18 Sep 1975. Filed date 11 Mar 1974. 8p.

Patent; design of Na--S battery with no S--metal corrosion problem. SODIUM-SULFUR BATTERIES;DESIGN;TUBES;CORROSION PROTECTION; SODIUM;SULFUR

928 GALVANIC POWER SUPPLY DEVICE WITH AT LEAST ONE GALVANIC CELL TO BE ACTIVATED BY ADDITION OF AN AQUEOUS SOLUTION, AND METHOD FOR ACTIVATING THIS CELL. Wijnen, M.D.; Boter, P.A. (to Philips Gloeilampenfabrieken NV). German(FRG) Patent 1,596,187/C/. 18 Sep 1975. 6p. (In German).

2 figs..

The purpose of the invention is to make a power supply device whose activable galvanic cell or cells can quickly deliver a relatively large energy relative to the volume of this cell, and whose parts used in delivering power through the cell can be easily replaced by new parts where necessary. The invention, furthermore, deals with foil material to use in a cell of such a power supply device which can replace similar used foil material in the cell.

929 PROCESS FOR OPERATING A GALVANIC CELL ARRANGEMENT WITH NEGATIVE ELECTRODES REACTING ELECTROCHEMICALLY WITH HALOGENS. Symons, P.C. (to Udylite Corp., Detroit, Mich. (USA)). German(FRG) Patent 2,128,198/B/. 18 Sep 1975. 14p. (In German).

9 figs..

The invention deals with a method to operate a galvanic cell arrangement with an electrode region of at least one chemically inert positive and a negative electrode, which is designed to have a metal layer which electrochemically reacts with halogens and an electrolyte having an aqueous metal halide solution which is led past the electrodes of the electrode region in the cycle, led out of electrode region and back again into the electrode region. The method is characterized in that the halogen formed in charging the cell arrangement is transformed into the halogen hydrate by cooling and is stored in the form of halogen hydrate in a storage region and is fed to the electrode region to produce current.

930 IMPACT-RESISTANT CELL FOR LEAD--ACID STORAGE BATTERIES. Sundberg, E.G. (to Aktiebolag Tudor). German(FRG) Patent 2,510,131. 18 Sep 1975. Filed date 6 Mar 1974. 15p.

An impact-resistant cell for lead--acid batteries is described. Rectangular electrodes are placed at an angle to the horizontal to prevent blocking of gas bubbles. The electrodes are set on an energy-absorbing material, e.g., rubber. Cell height is at least three times any other dimension.

931 CHEMICAL GENERATION OF ELECTRICAL ENERGY. Levine, C.A. (to Dow Chemical Co.). British Patent 1,406,106. 17 Sep 1975. Filed date 18 Oct 1972. 5p.

SODIUM-SULFUR BATTERIES;ANODES;CERAMICS; FIBERS;SODIUM SULFIDES;DESIGN;HEATERS

932 STORAGE BATTERY HAVING SPIRAL ELECTRODES. Frazier, W.N. US Patent 3,904,433. 9 Sep 1975. Filed date 29 Oct 1974. 6p.

LEAD-ACID BATTERIES;SPIRAL CONFIGURATION; ELECTRODES;DESIGN

933 SEALED LEAD STORAGE BATTERY. Sekido, S.; Fukuda, S.; Matsumoto, M.; Murakami, K. (to Matsushita Electric Industrial Co., Ltd.). US Patent 3,904,434. 9 Sep 1975. Priority date 17 Nov 1971, Japan. 6p.

Patent; overcomes problems due to generation of $H_2$ and $O_2$. LEAD-ACID BATTERIES;SEALS;GASES; HYDROGEN;OXYGEN;DESIGN;EMISSION;SAFETY

934 METHOD AND DEVICE FOR FEEDING CELLS OF AN ELECTROCHEMICAL BATTERY OF FORCED CIRCULATION TYPE. Pompon, J.P. (to Compagnie Generale d'Electricite). US Patent 3,902,918. 2 Sep 1975. Priority date 11 Dec 1973, France. 6p.

ZINC-AIR BATTERIES;DESIGN;ELECTROLYTES;PUMPS

935 LEAD STORAGE CELLS. Sundberg, E.G. (to Aktiebolag Tudor). German(FRG) Patent 2,507,654. 28 Aug 1975. Filed date 27 Feb 1974. 6p.

Patent; measures potential and stops discharge before dissolution of grid metals. LEAD-ACID BATTERIES;ELECTRIC POTENTIAL;CONTROL; DESIGN

936 STORAGE BATTERY. Papst, H. German(FRG) Patent 1,671,875. 28 Aug 1975. Filed date 18 Jul 1964. 4p.

ELECTRIC BATTERIES;DESIGN;GYPSUM

937 ALKALI METAL/SULFUR CELL WITH GAS FUEL CELL ELECTRODE. Ludwig, F.A. (to Ford Motor Co.). US Patent 3,951,689. 20 Aug 1975. vp.

An alkali metal/sulfur cell comprises one or more anodic reaction zones containing a molten alkali metal reactant-anode in electrical contact with an external circuit; one or more cathodic reaction zones including an electrode of porous conductive material and in which, during discharge of the cell, cations of the alkali metal combine with polysulfide ions to form alkali metal polysulfide salts which at least partially fill the porous conductive material; and a cation-permeable barrier to mass liquid transfer interposed between and in contact with the anodic and cathodic reaction zones, the porous conductive material being in electrical contact with both the cation-permeable barrier and the external circuit. The improvement comprises at least one cathodic reaction zone which is adapted to operate as a gas fuel cell electrode by employing a sulfur storage chamber containing molten sulfur connected with the cathodic reaction zone so as to allow sulfur vapors to pass between them. The storage chamber is adapted to be maintained at a temperature above the temperature of the cathodic reaction zone when the cell is being discharged such that sulfur distills into the cathodic reaction zone and below the temperature of the cathodic reaction zone when the cell is being charged such that sulfur vapor condenses in the storage chamber.

938 CARBON DIOXIDE CURING OF PLATES FOR LEAD--ACID BATTERIES. Yarnell, C.F. (to Bell Telephone Labs., Inc.). US Patent 3,899,349. 12 Aug 1975. Filed date 6 Feb 1974. 8p.

A process for curing lead--acid battery plates by exposing them to $CO_2$ in the presence of water is described. Since the cohesion of the active material is improved, a more open grid structure may be employed. The process is of value for both cathodes and anodes. (RWR)

939 STORAGE BATTERY. Nimmerrichter, W. German(FRG) Patent 2,403,222. 7 Aug 1975. Filed date 24 Jan 1974. 7p.

Patent; high capacity, small volume. ELECTRIC BATTERIES;DESIGN

940 THERMAL BATTERY. Bush, D.M.; Nissen, D.A. (to Energy Research and Development Administration). US Patent 3,898,101. 5 Aug 1975. Filed date 30 May 1974. 5p.

Patent; $Ca(OH)_2$-coated Ca anode, DEB pellet. METAL-METAL BATTERIES;DESIGN;CALCIUM;CALCIUM HYDROXIDES

941 LITHIUM--MOLTEN SALT CELL WITH TRANSITION METAL CHALCOGENIDE POSITIVE ELECTRODE. Heredy, L.; McCoy, L.R. (to Rockwell Int. Corp., El Segundo, CA). US Patent 3,898,096. 5 Aug 1975. Filed date 11 Jun 1973. 12p.

Patent; Li/alkali or alkaline earth metal halides with $Li^+$/transition metal chalcogenide. METAL-NONMETAL BATTERIES;LITHIUM-SULFUR BATTERIES;LITHIUM;ALKALI METAL COMPOUNDS; ALKALINE EARTH METAL COMPOUNDS;HALIDES;LITHIUM IONS;CATHODES;COPPER SULFIDES;IRON SULFIDES; NICKEL SULFIDES;NICKEL OXIDES;DESIGN

942 SECONDARY POWER CELL. Fraioli, A.V. US Patent 3,898,097. 5 Aug 1975. Filed date 11 Nov 1974. 10p.

Patent; alkali or alkaline earth metal anode. ELECTRIC BATTERIES;DESIGN;ANODES;ALKALI METALS;ALKALINE EARTH METALS;ALKALI METAL COMPOUNDS;ALKALINE EARTH METAL COMPOUNDS

943 THERMAL BATTERY. Bush, D.M.; Nissen, D.A. (to U.S. Energy Research and Development Administration). US Patent 3,898,101. 5 Aug 1975. Filed date 30 May 1974. 6p.

PAT-APPL-474,555.

An improved thermal battery and method for making it are described. This battery includes an electrically conductive heat generating disc positioned within each electrochemical cell, a calcium anode, a depolarizer--binder--electrolyte (DEB) mixture pellet, and a calcium hydroxide coating on the anode. 3 figures. (auth)

944 DRY ELECTROCHEMICAL CELL CONTAINING CUPRIC CHLORIDE SUPPORTED BY γ-ALUMINA. Aharoni, C.; Inbar, J.; Roker, M.; Rosenzweig, N. (Technion-Israel Inst. of Tech., Haifa). J. Appl. Chem. Biotechnol.; 25: No. 8, 591-596(Aug 1975).

An electrochemical cell was formed by enclosing a commercial catalyst containing cupric chloride supported by γ-alumina between electrodes of copper and iron. The voltage obtained is a logarithmic function of the vapour pressure of the water sorbed by the support. Voltages of a few hundred millivolts are obtained at relative pressure between 0.1 and 0.8 and temperatures between 25 and 170 C.

945 ALKALINE MANGANESE--ZINC GALVANIC CELL. Naumenko, V.A.; Lyapuntsova, T.G.; Lidorenko, N.S.; Lebedeva, E.S.; Pen'kova, L.F.; Aleshin, V.N. USSR Patent 479,182. 30 Jul 1975. Filed date 10 Apr 1970.

HYDROXIDES;LAMELLAE;ELECTRODES;ELECTRIC BATTERIES;ZINC;MANGANESE;DESIGN

946 ALKALINE BATTERY CELL. Devitt, J.L.; Stark, R.E.; Gillman, L.M. (to Gates Rubber Co., Denver, CO). US Patent 3,897,266. 29 Jul 1975. Filed date 3 Aug 1970. 10p.

NICKEL-ZINC BATTERIES;DESIGN;SEALS;DENDRITES

947 BATTERY WITH A SOLID FLUORIDE ION CONDUCTING ELECTROLYTE. Borger, W.; Hullmeine, U.; Voss, E. (to Varta Batterie AG). German(FRG) Patent 2,401,497. 24 Jul 1975. Filed date 12 Jan 1974. 9p.

Patent; Pb, Zn, Mg, or Cd/KRbPbR electrolyte/ $PhF_4$, $CuF_2$, or teflon. METAL-NONMETAL BATTERIES; DESIGN;LEAD;ZINC;MAGNESIUM;CADMIUM;LEAD FLUORIDES;COPPER FLUORIDES;TEFLON

948 HYDROGEN--BROMINE SECONDARY BATTERY. England, C. (to Calif. Inst. of Technology, Pasadena, CA). US Patent 3,894,887. 15 Jul 1975. Filed date 11 Jul 1973. 6p.

Patent; $H/H_3PO_4$/Br or other halogen. ELECTRIC BATTERIES;HALOGENS;HYDROGEN;INORGANIC ACIDS;AQUEOUS SOLUTIONS;ALKALI METAL COMPOUNDS; BROMIDES;BROMINE;LITHIUM BROMIDES;PHOSPHORIC ACID;HYDROGEN COMPOUNDS;HALIDES;SULFURIC ACID; SODIUM BROMIDES;POTASSIUM BROMIDES;DESIGN

949 HYDROGEN--BROMINE SECONDARY BATTERY. England, C. (to Calif. Inst. of Technology). US Patent 3,894,887. 15 Jul 1975. Filed date 11 Jul 1973. 5p.

Patent; water--$H_2SO_4$--LiBr electrolyte. METAL-NONMETAL BATTERIES;HYDROGEN;BROMINE; HALIDES;HYDROGEN IONS;ALKALI METAL COMPOUNDS; INORGANIC ACIDS;BROMIDES;PHOSPHORIC ACID; LITHIUM BROMIDES;WATER;SULFURIC ACID;DESIGN

950 GASTIGHT ELECTRIC STORAGE BATTERY WITH CHARGE-CONTROLLED ELECTRODES. Reber, H. German(FRG) Patent 1,571,997. 10 Jul 1975.

Filed date 28 Oct 1966. 5p.
ELECTRIC BATTERIES;BATTERY CHARGING; ELECTRODES;QUINONES;FORMALDEHYDE;GRAPHITE;WATER; BENZENE;PHENOL;DESIGN;SULFONIC ACID ESTERS

951 SILVER OXIDE CELL. Sugimoto, K.; Sakai, T. (to Daini Seikosha Co., Ltd.). German(FRG) Patent 2,440,246. 10 Jul 1975. Filed date 28 Dec 1973. 14p.
Patent; amorphous C added to cathodes to eliminate second voltage level. SILVER-ZINC BATTERIES;DESIGN;ELECTRIC POTENTIAL;ADDITIVES; CARBON;CATHODES

952 THIN-FILM CURRENT SOURCES ON BETA-AGI BASE. Kulinkovich, V.E.; Danilov, A.V.; Aleskovskij, V.B. (Leningradskij Tekhnologicheskij Inst. (USSR)). Elektrokhimiya; 11: No. 7, 1122-1125(Jul 1975). (In Russian).
Published in summary form only; for English translation see the journal Sov. Electrochem..
CHEMICAL PREPARATION;ELECTRIC CONDUCTIVITY; ELECTRIC CURRENTS;ELECTRIC POTENTIAL; ELECTROLYTES;FILMS;SILVER IODIDES;SOLIDS; TELLURIUM;PRIMARY BATTERIES;DESIGN

953 CYLINDRICAL LEAD--ACID STORAGE BATTERY CELL. Duddy, J.C. (to ESB Inc.). German(FRG) Patent 2,458,895. 26 Jun 1975. Filed date 13 Dec 1973. 11p.
Patent; $H_2SO_3$. LEAD-ACID BATTERIES; CYLINDRICAL CONFIGURATION;DESIGN;SULFUROUS ACID

954 BATTERY WITH RECHARGEABLE ZINC ELECTRODES. Von Benda, K. (to Deutsche Automobilgesellschaft mbH). German(FRG) Patent 2,364,203. 26 Jun 1975. Filed date 22 Dec 1973. 5p.
Patent; Zn dendrite growth prevented by auxiliary porous frame between cathode and anode. NICKEL-ZINC BATTERIES;DENDRITES;ZINC; DESIGN

955 STORAGE BATTERY. Kinsey, L.R. German(FRG) Patent 2,360,795. 26 Jun 1975. Filed date 6 Dec 1973. 22p.
Patent; replacment of active elements. LEAD-ACID BATTERIES;DESIGN;BATTERY CHARGING

956 BATTERY WITH FORCED CIRCULATION. Jacquelin, J. (to Compagnie Generale d'Electricite). German(FRG) Patent 2,457,283. 12 Jun 1975. Filed date 6 Dec 1973. 21p.
ELECTRIC BATTERIES;DESIGN;ELECTROLYTES; SUSPENSIONS

957 BATTERY WITH AT LEAST ONE ELEMENT. Elliott, R.C. (to ESB Inc.). German(FRG) Patent 2,440,640. 5 Jun 1975. Filed date 3 Dec 1973. 23p.
ELECTRIC BATTERIES;DESIGN

958 SEALED NICKEL--CADMIUM ALKALINE STORAGE BATTERY. Kasai, T.; Ito, Z.; Kanetsuki, K. (to Matsushita Electric Industrial Co., Ltd.). Japanese Patent 66,739. 5 Jun 1975. Filed date 17 Oct 1973. 4p.
Patent; $Ni(OH)_2$ cathode, $Cd(OH)_2$ anode. NICKEL-CADMIUM BATTERIES;SEALS;NICKEL HYDROXIDES;CADMIUM HYDROXIDES;LITHIUM HYDROXIDES;POTASSIUM HYDROXIDES;FABRICATION; CATHODES;PERFORMANCE

959 SEALED NICKEL--CADMIUM ALKALINE STORAGE BATTERY. Kasai, T.; Ito, Z.; Kanetsuki, K. (to Matsushita Electric Industrial Co., Ltd.). Japanese Patent 66,738. 5 Jun 1975. Filed date 17 Oct 1973. 3p.
Patent; cathode impregnated with LiOH. NICKEL-CADMIUM BATTERIES;SEALS;FABRICATION; CATHODES;NICKEL NITRATES;LITHIUM HYDROXIDES; PERFORMANCE

960 MODULAR ELECTROCHEMICAL CELL. Walsh, W.J.; Chilenskas, A.A.; Cairns, E.J.; Nelson, P.A. (to U.S. Energy Research and Development Administration). US Patent 3,887,396. 3 Jun 1975. Filed date 15 Nov 1973. 11p.
PAT-APPL-416,311.
Li or Na/LiF--LiCl--KCl/S, As, C mixture; patent. LITHIUM-SULFUR BATTERIES;SODIUM-SULFUR BATTERIES;HIGH TEMPERATURE;ALKALI METALS;SULFUR; ARSENIC;DESIGN;LITHIUM FLUORIDES;LITHIUM CHLORIDES;POTASSIUM CHLORIDES

961 METHOD FOR PRODUCING ELECTRICAL ENERGY WITH CONSUMABLE ALUMINIUM ANODE. Seiger, H.N. (to Textron Inc., Providence, RI). US Patent 3,887,399. 3 Jun 1975. Filed date 10 May 1971. 10p.
Patent; Al/chloride/Cl 135 W-hr/lb, 2 W-hr/$in.^3$. METAL-GAS BATTERIES;ALUMINIUM;CHLORINE; ANODES;CHEMICAL ACTIVATION;MERCURY ALLOYS; ALUMINIUM ALLOYS;ELECTRIC-POWERED VEHICLES; DESIGN;AQUEOUS SOLUTIONS;CALCIUM CHLORIDES; CHLORIDES;AMMONIUM COMPOUNDS

962 METHOD AND APPARATUS FOR ELECTROCHEMICALLY PRODUCING AN ELECTRIC CURRENT. Doniat, D.; Beccu, K.; Porta, A. (to Battelle Memorial Inst., S.A. Automobiles Citroen). US Patent 3,887,400. 3 Jun 1975. Filed date 14 May 1973. 12p.
ZINC-AIR BATTERIES;HYDROXIDES;DESIGN; ELECTROLYTES;LIQUID FLOW;ELECTRIC-POWERED VEHICLES

963 NONAQUEOUS ELECTROCHEMICAL TERM OUTLOOK. Quobex, J.; Gabano, J.P. Rev. Gen. Electr.; 84: No. 6, 491-496(Jun 1975). (In French).
The principle of functioning of electrochemical generators with lithium negative electrode and a nonaqueous electrolyte is explained first. next, the main problems to be solved with respect to each of their components are examined. The different couples in the process of development or in the commercial stage are described. An evaluation is made of the future of this type of system and of the chances of making it rechargeable.

964 ALKALINE BATTERY. Momose, K.; Ishihara, K.; Matsuo, K.; Iida, F. (to Matsushita Electric Industrial Co., Ltd.). Japanese Patent 14,731. 30 May 1975. Filed date 19 Sep 1970. 2p.
Patent; Zn/1,2,3-trihydroxybenzene/activated C--Ni. NICKEL-ZINC BATTERIES;ACTIVATED CARBON; SINTERED MATERIALS;NICKEL;PHENOLS;DESIGN

965 RECHARGEABLE SOLID STATE ELECTROCHEMICAL CELL HAVING A LITHIUM ANODE. Chenaux, B.; Feuillade, G. (to Compagnie Generale d'Electricite). British Patent 1,396,062. 29 May 1975. Filed date 12 Jul 1973. 5p.
Patent; average power = 20 μW. ELECTRIC BATTERIES;METHYLAL;ORGANIC POLYMERS;LITHIUM; ORGANIC ACIDS;ESTERS;DESIGN;COPPER SULFIDES; LITHIUM COMPOUNDS;CHLORATES;ANODES

966 STORAGE BATTERY. Dehmelt, K. (to

Emmerich, Christoph, KG). German(FRG) Patent 2,353,958. 28 May 1975. Filed date 27 Oct 1973. 21p.
NICKEL-CADMIUM BATTERIES;SEALS;HYDROXIDES; DESIGN

967 CELLS FOR AUTOMOBILE BATTERIES. Trippe, G.; Brinkmann, J. (to Varta Batterie AG). German(FRG) Patent 2,356,465. 28 May 1975. Filed date 12 Nov 1973. 11p.
Patent; shock-resistant spring-supported electrodes. LEAD-ACID BATTERIES;ELECTRODES; SUPPORTS;IMPACT SHOCK;SHOCK ABSORBERS;DAMPING; MECHANICAL VIBRATIONS;SPRINGS;RUBBERS;PLASTICS; AUTOMOBILES

968 THERMAL BATTERY. Bush, D.M. (to U.S. Energy Research and Development Administration). US Patent 3,885,989. 27 May 1975. Filed date 30 May 1974. 7p.
PAT-APPL-474,549.
Patent; Ca anode, electrolyte disk with calcium chromate depolarizer, $SiO_2$ binder, and KCl--LiCl--$Ca(OH)_2$ electrolyte; 16 and 65 mA/cm². METAL-METAL BATTERIES;DESIGN;PERFORMANCE; CALCIUM;CALCIUM COMPOUNDS;CHROMATES;SILICON OXIDES;POTASSIUM CHLORIDES;LITHIUM CHLORIDES; CALCIUM HYDROXIDES

969 BATTERY CELL. Bloom, S.M.; Hoffmann, A. (to Polaroid Corp.). US Patent 3,885,990. 27 May 1975. Filed date 9 Nov 1973. 3p.
Patent; Zn anode, aq. electrolyte with Hg salts. ELECTRIC BATTERIES;AQUEOUS SOLUTIONS; MERCURY COMPOUNDS;MERCURY COMPLEXES;MERCURY CHLORIDES;MERCURY IONS;ZINC;ANODES;CORROSION; DESIGN

970 METHOD AND APPARATUS FOR FILLING ADJACENT INSULATING TUBES FORMING THE POSITIVE PLATE OF A LEAD--ACID STORAGE BATTERY. Bohle, L. US Patent 3,885,988. 27 May 1975. Filed date 4 Oct 1973. 6p.
LEAD-ACID BATTERIES;CATHODES;TUBES; FABRICATION;AUTOMOBILES

971 ALKALINE BATTERY. Watanabe, M.; Daio, F. (to Matsushita Electric Industrial Co., Ltd.). Japanese Patent 59,741. 23 May 1975. Filed date 26 Sep 1973. 3p.
Patent; packing material based on chlorosulfonated polyethylene. AMINES;ORGANIC SULFUR COMPOUNDS;CARBAMATES;ORGANOMETALLIC COMPOUNDS;KETONES;TOLUENE;PIGMENTS; POLYETHYLENES;ORGANIC SULFUR COMPOUNDS;ORGANIC CHLORINE COMPOUNDS;HYDROXIDES;FABRICATION; FAILURES;ELECTRIC BATTERIES

972 GAS-TIGHT STORAGE BATTERY. Dehmelt, K. (to Emmerich, Christoph, KG). German(FRG) Patent 2,355,220. 22 May 1975. Filed date 5 Nov 1973. 24p.
NICKEL-CADMIUM BATTERIES;DESIGN;SEALS;TUBES

973 STORAGE BATTERY CELLS. Berndt, D.; Rabenstein, H.; Kalbitz, A. (to Varta Batterie AG). German(FRG) Patent 2,354,831. 22 May 1975. Filed date 2 Nov 1973. 10p.
LEAD-ACID BATTERIES;DESIGN;POLYSTYRENE; CONTAINERS;LEAD;LEAD OXIDES

974 NICKEL--ZINC BATTERY. Takamura, T.; Shirogami, T.; Sato, Y.; Murata, K.; Niki, H. (to Tokyo Shibaura Electric Co., Ltd.). German(FRG) Patent 2,454,820. 22 May 1975. Filed date 21 Nov 1973. 22p.
NICKEL-ZINC BATTERIES;FABRICATION;LAMELLAE; BATTERY SEPARATORS;MATERIALS

975 MULTILAYER BATTERIES HAVING INDIUM ANODES. Kawamura, C.; Takeuchi, K. (to Yuasa Battery Co., Ltd.). Japanese Patent 58,535. 21 May 1975. Filed date 25 Sep 1973. 2p.
Patent; In/$MnO_2$ with C separators. METAL-METAL OXIDE BATTERIES;INDIUM;MANGANESE OXIDES; LAYERS;CARBON;BATTERY SEPARATORS;DESIGN

976 RADIOACTIVE BATTERY. Deaton, R.L.; Silver, G.L. (to U.S. Energy Research and Development Administration). US Patent 3,884,718. 20 May 1975. Filed date 19 Apr 1973. 11p.
PAT-APPL-352,827.
Patent; voltaic cell. ELECTRIC BATTERIES; RADIOISOTOPE BATTERIES;DESIGN;OXIDATION; REDUCTION;HYDROBROMIC ACID

977 SECONDARY ELECTROCHEMICAL POWER-PRODUCING CELLS HAVING MIXED CATHODE COMPOSITION. Gay, E.C.; Shimotake, H.; Cairns, E.J.; Walsh, W.J. (to U.S. Energy Research and Development Administration). US Patent 3,884,715. 20 May 1975. Filed date 28 Sep 1973. 15p.
PAT-APPL-401,729.
Li/LiF--LiCl--KCl/S--As--C and Li/Se with cathode additives; patent. SELENIUM;THALLIUM; DESIGN;LITHIUM-SULFUR BATTERIES;LITHIUM FLUORIDES;LITHIUM CHLORIDES;POTASSIUM CHLORIDES; ARSENIC;ALUMINIUM;LITHIUM;METAL-NONMETAL BATTERIES

978 BUTTON TYPE GALVANIC CELL. Wuttke, K.G. (to du Pont de Nemours, E.I., and Co.). US Patent 3,884,723. 20 May 1975. Filed date 12 Oct 1973. 6p.
Patent; Li/dioxolane/CuS. METAL-NONMETAL BATTERIES;DESIGN;LITHIUM;COPPER SULFIDES; ORGANIC OXYGEN COMPOUNDS;HETEROCYCLIC COMPOUNDS

979 SECONDARY ELECTROCHEMICAL POWER-PRODUCING CELLS HAVING MIXED CATHODE COMPOSITION. Gay, E.C.; Shimotake, H.; Cairns, E.J.; Walsh, W.J. (to Energy Research and Development Administration). US Patent 3,884,715. 20 May 1975. Filed date 23 Feb 1972. 10p.
Patent; alkali metal/alkali metal ions/chalcogen mixed with inhibitor of chalcogen activity (e.g. Se, S + Al, As, Pb, or Tl). LITHIUM-SULFUR BATTERIES;METAL-NONMETAL BATTERIES;LITHIUM;ALKALI METALS;IONS; ELECTROLYTES;CATHODES;SULFUR;SELENIUM;THALLIUM; LEAD;ARSENIC;ALUMINIUM;DESIGN

980 METHOD OF ACTIVATING STORAGE BATTERIES. Badger, J.P.; Bernholtz, H.A. (to Eltra Corp.). US Patent 3,884,724. 20 May 1975. Filed date 12 Nov 1970. 6p.
A method of activating a storage battery of the water-activable type is described in which concentrated acid held in semi-solid, granular, or liquid form is placed within the battery by the manufacturer and then, at the point of sale, is released by the addition of water, which combines with the concentrated acid to form the battery electrolyte. The method of this invention utilizes a battery construction in which the stored acid is held in a battery compartment separated from the plates and in which the added water is caused to percolate through the concentrate and is withheld from contact with the plates for a time sufficient to form a battery electrolyte having a predetermined minimum concentration or specific

gravity. (auth)

981 ZINC ANODE BATTERY. Kobayashi, S.; Kosugi, H.; Momose, K. (to Matsushita Electric Industrial Co., Ltd.). Japanese Patent 55,839. 16 May 1975. Filed date 18 Sep 1973. 2p.
Patent; coating of 2,6-di-tert-butyl-p-cresol to extend shelf life and inhibit H evolution. SILVER-ZINC BATTERIES;NICKEL-ZINC BATTERIES;ZINC-MANGANESE BATTERIES;ELECTRIC BATTERIES;ANODES;STORAGE;LIFETIME;ETHANOL;GASES; ZINC-AIR BATTERIES;ZINC-CHLORINE BATTERIES; CRESOLS

982 SODIUM--SULFUR BATTERY. Lazennec, Y.; Lasne, C. (to Compagnie Generale d'Electricite). French Patent 2,248,617. 16 May 1975. Filed date 17 Oct 1973. 9p.
SODIUM-SULFUR BATTERIES;ALUMINIUM OXIDES; DESIGN;GLASS;BORON SILICATES;TUBES

983 SECONDARY ALKALINE BATTERY. Ohsawa, K. (to Furukawa Electric Co., Ltd.). Japanese Patent 54,843. 14 May 1975. Filed date 14 Sep 1973. 3p.
ZINC-AIR BATTERIES;HYDROXIDES;MANGANESE HYDROXIDES;DESIGN;MANGANESE HYDROXIDES

984 IRON--OXYGEN BATTERY. Matsumoto, I.; Kobayashi, Y.; Eguchi, T.; Ishikawa, T.; Iwaki, T.; Fukuda, M. (to Agency of Industrial Sciences and Technology). Japanese Patent 54,844. 14 May 1975. Filed date 14 Sep 1973. 3p.
Patent; S-containing KOH electrolyte. METAL-GAS BATTERIES;IRON;OXYGEN;POTASSIUM HYDROXIDES; FABRICATION;CATALYSTS;POTASSIUM SULFIDES

985 CYLINDRICAL NICKEL--CADMIUM BATTERY. Yoshida, S. (to Yuasa Battery Co., Ltd.). Japanese Patent 54,847. 14 May 1975. Filed date 14 Sep 1973. 3p.
Patent; anode = substrate posted with CdO, electroconductive material, $H_2O$, organic solvent, and binder. NICKEL-CADMIUM BATTERIES; CYLINDRICAL CONFIGURATION;ANODES;FABRICATION; TESTING;DESIGN;CADMIUM OXIDES;NICKEL;WATER;PVA; GLYCEROL;BINDERS;SHEETS

986 WATER-ACTIVATED BATTERY. Tsubaki, K.; Yasuda, T.; Ogawa, H. (to Matsushita Electric Industrial Co., Ltd.). Japanese Patent 54,841. 14 May 1975. Filed date 14 Sep 1973. 5p.
Patent; hydrophilic resin on cathode. LEAD-ACID BATTERIES;CATHODES;PVA;DESIGN;CELLULOSE ESTERS;FLUOROBORATES;INORGANIC ACIDS;RESINS

987 ALKALINE ALUMINIUM--AIR/ZINC--MANGANESE DIOXIDE HYBRID BATTERY. Kordesch, K.V.; Kozawa, A. (to Union Carbide Corp.). US Patent 3,883,368. 13 May 1975. Filed date 26 Oct 1972. 8p.
PRIMARY-SECONDARY HYBRID BATTERIES;ZINC-MANGANESE BATTERIES;POWER SUPPLIES;OPERATION; DESIGN;USES

988 REMOVAL OF SULFUR FROM BATTERY WRECKER MATERIAL USING AMMONIUM CARBONATE SOLUTION. Acoveno, F.A.; Freudiger, T.W. (to RSR Corp.). US Patent 3,883,348. 13 May 1975. Filed date 6 Sep 1973. 8p.
LEAD-ACID BATTERIES;WASTE PROCESSING;SULFUR OXIDES;SULFUR;AMMONIUM COMPOUNDS;CARBONATES

989 HIGH ENERGY DENSITY LONG LIFE ALKALINE BATTERY. Iwaki, T.; Mori, M.; Shimono, N. (to Matsushita Electric Industrial Co., Ltd.). Japanese Patent 53,843. 13 May 1975. Filed date 13 Sep 1973. 4p.
IRON-NICKEL BATTERIES;FABRICATION;SINTERED MATERIALS;COMPARATIVE EVALUATIONS

990 ORGANIC ELECTROLYTE BATTERY WITH HIGH ENERGY DENSITY. Morita, A.; Iijima, T. (to Matsushita Electric Industrial Co., Ltd.). Japanese Patent 1975-52,531. 10 May 1975. Filed date 10 Sep 1973. 3p.
The anode for this battery was prepared by pressing a Ni screen against a Li sheet. The cathode was fabricated by pressing a mixture of solid fluorinated graphite, acetylene black, and teflon against both sides of a Ni screen. A fabric separator was used. The battery was filled with a mixture of $LiBF_4$, propylene carbonate, and dimethyl sulfoxide. Such a battery had a higher voltage than a similar one without dimethyl sulfoxide; its discharge characteristics were also better. (RWR)

991 RECHARGEABLE THERMAL BATTERY. Rabenstein, H. (to Varta Batterie AG). German(FRG) Patent 2,352,042. 7 May 1975. Filed date 17 Oct 1973. 7p.
Patent; Li anode and depolarizer (Br)-containing porous plate float on alkali metal halide electrolyte. ELECTRIC BATTERIES;LITHIUM; ALKALI METAL COMPOUNDS;HALIDES;DESIGN; ELECTROLYTES

992 AIR CELL. Tsuchida, T.; Shinoda, K.; Yamamoto, K.; Murata, T. (to Fuji Electrochemical Co., Ltd.). US Patent 3,881,959. 6 May 1975. Filed date 2 Aug 1973. 4p.
METAL-GAS BATTERIES;DESIGN

993 HIGH POWER BATTERY FOR AMERICAN ELECTRIC CARS. Electr. Rev. (London); 196: No. 17, 525(2 May 1975).
A high-power-density lithium--sulfur battery was developed at the US Argonne National Laboratory. Three firms, Gould, Eagle Pitcher, and Catalyst Research, who co-operated in the research program, were awarded a total of $400,000 worth of contracts for fabrication of test cells and electrodes. (Fuel Abstr.)

994 SPACELAB POWER SUPPLY SYSTEMS. Blydt-Hansen, T. (Aeg-Telefunken, Hamburg, Germany). Elektro-Anz.; 7: No. 5, 123-6(May 1975). (In German).
7 kw continuous 12 kw peak fuel cell with Ag--Zn battery. SPACECRAFT POWER SUPPLIES;SILVER-ZINC BATTERIES;FUEL CELLS;HYBRID SYSTEMS

995 NICKEL--IRON SECONDARY BATTERIES. Iwaki, T.; Kobayashi, Y. (to Matsushita Electric Industrial Co., Ltd.). Japanese Patent 48,431. 30 Apr 1975. Filed date 31 Aug 1973. 3p.
IRON-NICKEL BATTERIES;DESIGN;POLYPROPYLENE; BATTERY SEPARATORS;PERFORMANCE

996 SODIUM--SULFUR CELL. Kimura, S.; Furuse, T. (to Yuasa Battery Co., Ltd.). Japanese Patent 11,049. 26 Apr 1975. Filed date 8 Jun 1968. 4p.
Patent; alumina electrolyte with $Na_2O$ and CaO. SODIUM-SULFUR BATTERIES;SINTERED MATERIALS; ALUMINIUM OXIDES;SODIUM OXIDES;CALCIUM OXIDES;

DESIGN

997 BATTERY WHOSE BATTERY CHAMBER CONTAINS A LIQUID-ABSORBING MATERIAL, ACTIVATED BY ELECTROLYTE CHARGING, AND METHOD OF INTRODUCING THE LIQUID-ABSORBING MATERIAL. Neuber, K. (to Telefunken Patentverwertungsgesellschaft mbh). German(FRG) Patent 1,496,266/C/. 24 Apr 1975. 3p. (In German).
1 fig..
A primary battery which is activated only shortly before using by filling with an electrolyte and which is to be preferably used in endoradioprobes as electric energy source is dealt with here. According to the invention, molecular sieves are used for absorbing or as carriers of the aqueous electrolytes.

998 ZINC ALKALINE SECONDARY BATTERIES. Ohsawa, K. (to Furukawa Electric Co., Ltd.). Japanese Patent 43,435. 19 Apr 1975. Filed date 22 Aug 1973. 4p.
Patent; auxiliary anode and polycationic polymer prevent Zn dendrite formation and H generation. ZINC;ANODES;ELECTRIC BATTERIES; NICKEL-ZINC BATTERIES;SILVER-ZINC BATTERIES; ZINC-MANGANESE BATTERIES;AQUEOUS SOLUTIONS; HYDROXIDES;DENDRITES;CELLULOSE;POTASSIUM HYDROXIDES;PERFORMANCE;DESIGN;POLYMERS;HYDROGEN; GASES

999 SEALED BATTERY AND METHOD FOR ITS ACTIVATION. Cercone, R.; Dennison, E.S. (to Yardney International Corp.). GE 2,447,459. 17 Apr 1975. Filed date 11 Oct 1973. 11p.
2 Metal electrodes, anode electrolyte of solid KOH mixed with Zn; patent. METAL-METAL BATTERIES;DESIGN;NICKEL;ZINC;COPPER;POTASSIUM HYDROXIDES;HEATERS

1000 SECONDARY ALKALINE BATTERIES. Ohsawa, K. (to Furukawa, Electric Co., Ltd.). Japanese Patent 42,345. 17 Apr 1975. Filed date 20 Aug 1973. 4p.
Patent; Zn anode, addition of polycationic polymers enables charging without Zn deposition. ZINC;ANODES;HYDROXIDES;POTASSIUM HYDROXIDES;NICKEL-ZINC BATTERIES;ELECTRIC POTENTIAL;ELECTRIC BATTERIES;BATTERY CHARGING; CHEMICAL REACTIONS;SILVER-ZINC BATTERIES; ELECTROLYTES;POLYMERS;QUATERNARY COMPOUNDS

1001 ZINC--ALKALINE BATTERY CONTAINING CARBAZOLE AS A ZINC CORROSION INHIBITOR. Tochikubo, I.; Yokoyama, K.; Kirihara, T. (to Hitachi Makuseru Co., Ltd.). Japanese Patent 42,341. 17 Apr 1975. Filed date 18 Aug 1973. 4p.
ELECTRIC BATTERIES;SILVER-ZINC BATTERIES; NICKEL-ZINC BATTERIES;ZINC-MANGANESE BATTERIES; CARBAZOLES;CORROSION INHIBITORS;ZINC;ANODES; HYDROXIDES;CELLULOSE;POTASSIUM HYDROXIDES; MANGANESE OXIDES;GRAPHITE;ELECTRIC POTENTIAL; PERFORMANCE;STORAGE

1002 ALKALI METAL--METAL CHLORIDE BATTERY. Werth, J.J. (to ESB Inc.). US Patent 3,877,984. 15 Apr 1975. Filed date 24 Apr 1974. 7p.
Patent; typical example, Na/alkali metal chloroaluminate/$SbCl_3$, cell temperature 180-200°. METAL-NONMETAL BATTERIES;SODIUM;ANTIMONY CHLORIDES;CHLORIDES;ALKALI METALS;ALUMINATES; CHLORINE COMPOUNDS;MEDIUM TEMPERATURE;OPERATION; DESIGN

1003 ALKALINE MANGANESE DIOXIDE BATTERY. Naumenko, V.A.; Lyapuntsova, T.G.; Lidorenko, N.S.; Lebedeva, E.S.; Pen'kova, L.F.; Aleshin, V.N. German(FRG) Patent 2,342,140. 10 Apr 1975. Filed date 21 Aug 1973. 15p.
Patent; large-capacity battery with stacked plates. ZINC-MANGANESE BATTERIES;DESIGN; SUPPORTS;PLATES

1004 SODIUM SULFUR BATTERY. Kogiso, T.; Hayashi, H. (to Toyota Central Research and Development Labs., Inc.). Japanese Patent 38,030. 9 Apr 1975. Filed date 11 Aug 1973. 10p.
Patent; minimized Na--S explosion hazard. SODIUM-SULFUR BATTERIES;DESIGN;ELECTROLYTES; SOLIDS;SAFETY ENGINEERING;HAZARDS;CHEMICAL EXPLOSIONS

1005 FUSED SALT BATTERY. Yamasaki, H.; Yamane, T. (to Matsushita Electric Industrial Co., Ltd.). Japanese Patent 38,032. 9 Apr 1975. Filed date 9 Aug 1973. 4p.
Ca/KCl--LiCl/Ni; patent. METAL-METAL BATTERIES;CALCIUM;NICKEL;MOLTEN SALTS;BATTERY SEPARATORS;GLASS;ASBESTOS;PAPER;POTASSIUM CHLORIDES;LITHIUM CHLORIDES;HIGH TEMPERATURE; PERFORMANCE;DESIGN

1006 ZINC PLATE SHAPE CHANGE INHIBITION. McBreen, J. (to General Motors Corp.). US Patent 3,876,470. 8 Apr 1975. Filed date 29 Nov 1972. 6p.
Patent; frame near electrode saturated with $Fe(OH)_2$. NICKEL-ZINC BATTERIES;SILVER-ZINC BATTERIES;ZINC-MANGANESE BATTERIES;IRON HYDROXIDES;ANODES;SHAPE;ELECTRODES

1007 ALKALINE MANGANESE SECONDARY BATTERY. Uetani, Y.; Shimizu, A.; Tsubuya, Y.; Matsushima, S.; Kozeke, T.; Ishikawa, Y.; Yumimoto, O. (to Hitachi Makuseru Co., Ltd.). Japanese Patent 35,634. 4 Apr 1975. Filed date 3 Aug 1973. 3p.
Patent; alkaline earth hydroxide between anode and cathode. ZINC-MANGANESE BATTERIES; HYDROXIDES;AQUEOUS SOLUTIONS;ALKALINE EARTH METAL COMPOUNDS;GRAPHITE;WATER;TUBES;CATHODES; FABRICATION;POTASSIUM HYDROXIDES;CALCIUM HYDROXIDES;BATTERY SEPARATORS;ZINC ALLOYS; MERCURY ALLOYS;ANODES;PERFORMANCE

1008 ALKALINE MANGANESE SECONDARY BATTERY. Uetani, Y.; Shimizu, A.; Tsubuya, Y.; Matsushima, S.; Kozeke, T.; Ishikawa, Y.; Yumimoto, O. (to Hitachi Makuseru Co., Ltd.). Japanese Patent 35,635. 4 Apr 1975. Filed date 7 Aug 1973. 3p.
Patent; anode with alkaline earth hydroxide added to Zn. ZINC-MANGANESE BATTERIES; HYDROXIDES;AQUEOUS SOLUTIONS;FABRICATION; PERFORMANCE;ALKALINE EARTH METAL COMPOUNDS; TUBES;CATHODES;GRAPHITE;PARAFFIN;SUSPENSIONS; ANODES;POTASSIUM HYDROXIDES;ZINC ALLOYS;MERCURY ALLOYS;POWDERS;CALCIUM HYDROXIDES;CELLULOSE

1009 ZINC ELECTRODE FOR ALKALINE BATTERY. Henssen, H.F. (to Deutsche Carbone AG). German(FRG) Patent 2,345,514. 3 Apr 1975. Filed date 8 Sep 1973. 12p.
Patent; portable gel-free alk.--air battery using Zn anode containing Zn amalgam granules. ZINC;ANODES;ZINC-AIR BATTERIES;POTASSIUM HYDROXIDES;MERCURY ALLOYS;ZINC ALLOYS; FABRICATION

1010 HERMETICALLY SEALED SECONDARY BATTERY WITH LANTHANUM NICKEL ANODE. Will, F.G. (to

General Electric Co.). US Patent 3,874,928. 1 Apr 1975. Filed date 29 Jun 1973. 4p.
Patent; Ni hydroxide/KOH/$LaNi_5$. METAL-NONMETAL BATTERIES;LANTHANUM ALLOYS;NICKEL BASE ALLOYS;NICKEL HYDROXIDES;POTASSIUM HYDROXIDES; FABRICATION

1011 BATTERY FILLING DEVICE. Zangrando, R.A. US Patent 3,874,934. 1 Apr 1975. Filed date 8 Mar 1974. 4p.
A battery filling device which, upon manual actuation of a pull ring, automatically transfers liquid electrolyte from a flexible storage container into the cells of a battery. The filling device comprises a housing having chambered sections therein separated by a manifold distributing section. The flexible container and the electrolyte therein are initially contained in an upper chamber. A portion of the container is positioned between the coils of a partially uncoiled portion of a spring metal sheet. The metal sheet is spring formed to roll itself into a cylindrical form when it is unrestrained. The coil is restrained from rolling up upon itself initially by the presence of the filled electrolyte container positioned thereon. Upon actuation of the pull ring, a spring biased valve opens an orifice in the storage container and releases the electrolyte. As the electrolyte disperses through the manifold section to the battery cells located in a lower chamber, the metal sheet coil squeezes the empty section of the flexible container flat so that the spring-biased metal sheet can assume its cylindrical shape by rolling up the flexible container between its coils. The rolling action of the metal sheet helps to squeeze the electrolyte out of the orifice into the distribution manifold. 3 figures. (auth)

1012 ADVANCED BATTERY DESIGN. Potter, D.E. Electr. Eng. (Melbourne); 52: No. 4, 49-52(Apr 1975).
Developments in battery design for electric vehicles are reviewed. Advantages and disadvantages of various types are discussed. Battery types dealt with include the sodium/sulfur, the lithium/sulfur, the zinc/chloride, and the zinc/oxygen batteries.

1013 BATTERY WITH NONAQUEOUS ELECTROLYTE. Tsuchida, T.; Shinoda, K.; Yamamoto, K.; Ohta, H.; Ishiguro, Y. (to Fuji Electrochemical Co., Ltd.). Japanese Patent 33,419. 31 Mar 1975. Filed date 2 Aug 1973. 4p.
Patent; alkali metal (Li)/$LiClO_4$--propylene carbonate/$MoO_3$ or $CuF_2$; molecular sieve. METAL-NONMETAL BATTERIES;DESIGN;ALKALI METALS;LITHIUM; MOLYBDENUM OXIDES;COPPER FLUORIDES; POLYPROPYLENE;GRAPHITE;MOLECULAR SIEVES;LITHIUM COMPOUNDS;CHLORATES;CARBONIC ACID DERIVATIVES; PERFORMANCE

1014 SODIUM--SULFUR BATTERIES. Kogibu, T.; Hayashi, H. (to Toyota Central Research and Development Labs., Inc.). Japanese Patent 33,420. 31 Mar 1975. Filed date 30 Jul 1973. 6p.
Patent; Na reservoir separated from β-alumina cup for improved safety. SODIUM-SULFUR BATTERIES;DESIGN;ALUMINIUM OXIDES;SAFETY

1015 ALKALINE STORAGE BATTERIES. Iwaki, T.; Mori, M.; Shimono, N. (to Matsushita Electric Industrial Co., Ltd.). Japanese Patent 33,433. 31 Mar 1975. Filed date 2 Aug 1973. 3p.
HYDROXIDES;IRON-NICKEL BATTERIES;SINTERED MATERIALS;ELECTRODES;THICKNESS;POTASSIUM HYDROXIDES;LITHIUM HYDROXIDES;POTASSIUM SULFIDES;PERFORMANCE;FABRICATION;DESIGN

1016 ALKALINE STORAGE BATTERY MANUFACTURING PROCESSES WITHOUT WASTE SOLUTION RELEASE. Matsuki, S.; Yasumura, S.; Maki, Y.; Hoshino, H.; Hatano, H. (to Shin-Kobe Electric Machinery Co., Ltd.). Japanese Patent 33,429. 31 Mar 1975. Filed date 30 Jul 1973. 6p.
HYDROXIDES;ELECTRIC BATTERIES;FABRICATION; WASTE PROCESSING;ION EXCHANGE

1017 LAMINATED LEAD STORAGE BATTERY. Kawamura, C.; Igarashi, H. (to Agency of Industrial Sciences and Technology). Japanese Patent 32,441. 29 Mar 1975. Filed date 28 Jul 1973. 3p.
Patent; composite bipolar electrodes. LEAD-ACID BATTERIES;FABRICATION;CARBON;POWDERS; BENZENE;POLYSTYRENE;LEAD;FILMS;PERFORMANCE; TESTING

1018 LAMINATED STORAGE BATTERY WITH TITANIUM ELECTROCONDUCTIVE PLATE. Kawamura, C.; Igarashi, H. (to Agency of Industrial Sciences and Technology). Japanese Patent 32,440. 29 Mar 1975. Filed date 28 Jul 1973. 3p.
Patent; bipolar-electrode plates, 100 cycles. ELECTRIC BATTERIES;LAYERS;TITANIUM ALLOYS;TITANIUM;FABRICATION;DESIGN;SHEETS; PERFORMANCE

1019 ZINC ALKALINE BATTERY. Tochikubo, I.; Yokoyama, K.; Kirihara, S. (to Hitachi Makuseru Co., Ltd.). Japanese Patent 32,437. 29 Mar 1975. Filed date 27 Jul 1973. 4p.
ZINC-MANGANESE BATTERIES;ZINC;CORROSION PROTECTION;ANODES;GASES;CARBOXYLIC ACIDS;THIOLS

1020 NICKEL--CADMIUM BATTERY ELECTRODE MANUFACTURE WITH WASTE WATER RECYCLING PROCESSES. Matsuki, S.; Shima, T.; Sasaki, N.; Yasumura, S.; Hoshino, H. (to Shin-Kobe Electric Machinery Co., Ltd.). Japanese Patent 32,446. 29 Mar 1975. Filed date 26 Jul 1973. 4p.
NICKEL-CADMIUM BATTERIES;ELECTRODES; FABRICATION;WASTE WATER;WASTE PROCESSING

1021 ZINC--HALOGEN ELECTRIC CELL. (to Unigate Ltd.). German(FRG) Patent 2,440,622. 27 Mar 1975. Filed date 14 Sep 1973. 11p.
Patent; reservoir for halogen solvent, 1 to 10 atm. METAL-GAS BATTERIES;ZINC;HALOGENS;ZINC-CHLORINE BATTERIES;MEDIUM PRESSURE;DESIGN

1022 ALKALINE CELL WITH ZINC ANODE. Ohhira, T.; Ikeda, Y.; Yokoyama, T.; Sekido, S. (to Matsushita Electric Industrial Co., Ltd.). Japanese Patent 30,028. 26 Mar 1975. Filed date 20 Jul 1973. 3p.
NICKEL-ZINC BATTERIES;PERFORMANCE;SILVER-ZINC BATTERIES;ZINC-MANGANESE BATTERIES; DENDRITES;DESIGN

1023 SECONDARY BATTERY WITH NONCONSUMABLE SILICON CATHODE. Hoekje, H.H.; Dietz, P.L. (to PPG Industries, Inc.). German(FRG) Patent 2,444,147. 20 Mar 1975. Filed date 19 Sep 1973. 27p.
Patent; Zn/Br with $RuO_2$- coated Si cathode; preparation. METAL-NONMETAL BATTERIES;ZINC; BROMINE;SILICON;RUTHENIUM OXIDES;TITANIUM OXIDES;COATINGS;CHEMICAL PREPARATION;

FABRICATION;CATHODES

1024 LAMINATED SILVER OXIDE BATTERY. Sako, S.; Taniguchi, Y.; Fukumoto, H. (to Yuasa Battery Co., Ltd.). Japanese Patent 27,043. 20 Mar 1975. Filed date 11 Jul 1973. 3p.
Patent; Zn or ZnO anode, fabrication. SILVER-ZINC BATTERIES;ZINC;ZINC OXIDES;ANODES; FABRICATION;FIBERS;PVA

1025 FLAT ALKALINE CELL CONSTRUCTION. Beatty, T.R.; Vourlis, H. (to Union Carbide Corp.). US Patent 3,871,921. 18 Mar 1975. Filed date 1 Apr 1974. 9p.
Patent; high energy density battery. ELECTROLYTES;BASES;ELECTRODES;SEALS;PLASTICS; FILMS;DESIGN;ELECTRIC BATTERIES

1026 ZINC ALKALINE STORAGE BATTERY. Ikeda, Y.; Ohhira, T.; Yokoyama, T.; Sekido, S. (to Matsushita Electric Industrial Co., Ltd.). Japanese Patent 26,040. 18 Mar 1975. Filed date 6 Jul 1973. 3p.
Patent; Ni/KOH, KF/$ZnF_2$. NICKEL-ZINC BATTERIES;ZINC FLUORIDES;FLUORINE IONS;LIFETIME; ANODES;NICKEL;SINTERED MATERIALS;POLYAMIDES;PVA; POTASSIUM HYDROXIDES;POTASSIUM FLUORIDES; PERFORMANCE;FABRICATION

1027 ZINC ALKALINE STORAGE BATTERY. Ikeda, Y.; Ohhira, T.; Yokoyama, T.; Sekido, S. (to Matsushita Electric Industrial Co., Ltd.). Japanese Patent 26,044. 18 Mar 1975. Filed date 6 Jul 1973. 3p.
Patent, KOH electrolyte with KF. FLUORINE IONS;ELECTROLYTES;ZINC;EROSION;OXIDATION;ZINC-AIR BATTERIES;NICKEL;ZINC OXIDES;PVA;POLYAMIDES; POTASSIUM HYDROXIDES;POTASSIUM FLUORIDES; PERFORMANCE;FABRICATION

1028 ZINC ALKALINE BATTERY. Ikeda, Y.; Ohhira, T.; Yokoyama, T.; Sekido, S. (to Matsushita Electric Industrial Co., Ltd.). Japanese Patent 26,041. 18 Mar 1975. Filed date 6 Jul 1973. 3p.
Patent; Ni/KOH/$ZnF_2$. NICKEL-ZINC BATTERIES; ANODES;ZINC FLUORIDES;NICKEL;SINTERED MATERIALS; POLYAMIDES;PVA;POTASSIUM HYDROXIDES;PERFORMANCE; ZINC OXIDES;COMPARATIVE EVALUATIONS;FABRICATION

1029 STORAGE BATTERY. Ikeda, S. (to Yuasa Battery Co., Ltd.). US Patent 3,871,923. 18 Mar 1975. Priority date 14 Dec 1972, Japan. 6p.
This invention relates to a storage battery provided with an improved liquid feeding device and gas exhausting device. This storage battery is formed of a storage battery provided with a monoblock battery container containing such battery elements as plates and separators for each cell and with a novel liquid feeding device and gas exhausting device in a lid. The liquid feeding device has a liquid supplying part communicating with a water tank or an air source and with each cell through an electrolyte level setting tube. The gas exhausting device is formed by containing a valve which closes the passages into each cell at the time of feeding the liquid but can open the above mentioned passage when oxygen and hydrogen gases generated within the storage battery are to be replaced with air fed into each cell from the liquid supplying part. The storage battery of the present invention, by the above mentioned liquid feeding device and gas exhausting device, enables liquid to be safely fed to a fixed level without an explosion within the battery and also allows the operation to be carried out very simply and positively. (auth)

1030 NEGATIVE ACTIVE SUBSTANCE FOR A STORAGE CELL. Gabano, J.P.; Jumel, Y. (to Saft-Societe Des Accumulateurs Fixes Et De Traction). US Patent 3,871,917. 18 Mar 1975. Priority date 9 Jun 1972, France. 18p.
The negative active material for a storage cell having an acid electrolyte, whose positive is constituted by the electrochemical system $PbO_2/H_2SO_4/PbSO_4$, is composed of molybdenum oxides such that the average value of the valency be comprised between 4 and 6. The oxides concerned are, more particularly, mixed oxides of $MoO_2$ and $MoO_3$. The oxygen reducing system thus obtained may be as follows: $MoO_3$ . 4 $MoO_2$ + $2H^+$ 2e in equilibrium 5 $MoO_2$ + $H_2O$. The corresponding storage cell is characterized by a very low sulphuric acid consumption on discharging and increased stability of the capacity during the idle periods of the storage cell in the charged state. It is recommended to compress the active material before assembly and to apply compression on operation to prevent that substance from disintegrating and scattering. 11 figures. (auth)

1031 FLAT ALKALINE CELL CONSTRUCTION AND METHOD FOR ASSEMBLING THE SAME. Beatty, T.R.; Vourlis, H. (to Union Carbide Corp.). US Patent 3,871,921. 18 Mar 1975. Filed date 1 Apr 1974. 14p.
A flat alkaline cell is described which comprises an electrode assembly including at least a pair of flat electrode elements of opposite polarity and a porous separator containing the alkaline electrolyte interposed between and in contact with the pair of electrode elements. The electrode assembly is enclosed within a sealed, liquid-impervious plastic film envelope having an opening in one wall thereof and wherein flat internal and external current collectors are disposed adjacent to the inner and outer sides of the wall, respectively, overlying the opening. The collectors are tightly adhered to the respective sides of the wall by thin layers of an adhesive sealant which is non-wettable by the alkaline electrolyte. Means are provided for making electrical connection between the current collectors through the opening in the wall. Also disclosed is a method for assembling the flat cell wherein a composite collector-wall member is formed prior to completion of the sealed envelope. 5 figures. (auth)

1032 ZINC ALKALINE SECONDARY BATTERY. Ishida, O.; Noda, M. (to Hitachi Maxell, Ltd.). Japanese Patent 24,738. 17 Mar 1975. Filed date 13 Jun 1973. 4p.
Patent; safe battery because of smooth gas removal at anode. NICKEL-ZINC BATTERIES;SILVER-ZINC BATTERIES;ZINC-MANGANESE BATTERIES; HYDROXIDES;ZINC;ELECTRIC BATTERIES;SAFETY; DESIGN

1033 FUNDAMENTAL RESEARCH ON THE SELECTION OF NEW ELECTROCHEMICAL GENERATORS OF MEDIUM POWER. Bonnemay, M. (CNRS, Lab. d'Electrolyse, Bellevue, Hauts-de-Seine; Conservatoire National des Arts et Metiers, Paris, France); Bronoel, G.; Sarradin, J. (CNRS, Paris, France). Sci. Tech. (Paris); 13-21(15 Mar 1975). (In French).
ELECTRIC BATTERIES;RESEARCH PROGRAMS;LEAD-ACID BATTERIES;FABRICATION;OXYGEN;HYDROGEN; CATHODES;METAL-GAS BATTERIES;DESIGN;PLANNING

1034 STORAGE BATTERY. Mclean, T.F. (to Chloride Batteries Australia Ltd.). German(FRG) Patent 2,443,422. 13 Mar 1975. Filed date 12 Sep 1973. 32p.
LEAD-ACID BATTERIES;FABRICATION

1035 SILVER OXIDE CELL. Sugimoto, K.; Sakai, T. (to Daini Seikosha Co., Ltd.). German(FRG) Patent 2,440,245. 13 Mar 1975. Filed date 11 Sep 1973. 14p.
Patent; anode with 10 percent Hg, cathode with 0.5 to 2 percent activated C, NaOH or KOH electrolyte with ZnO and halide or halooxygen salts. SILVER-ZINC BATTERIES;ZINC ALLOYS; MERCURY ALLOYS;SILVER OXIDES;ACTIVATED CARBON; ZINC OXIDES;SODIUM HYDROXIDES;POTASSIUM HYDROXIDES;HALIDES;DESIGN;OXYGEN COMPOUNDS; HALOGEN COMPOUNDS;SALTS

1036 ALKALINE CELL. Takamura, I.; Kanada, Y.; Suzuki, S. (to Tokyo Shibaura Electric Co., Ltd.). US Patent 3,870,564. 11 Mar 1975. Filed date 30 Mar 1973. 6p.
Patent; Zn anode and alkaline electrolyte. SILVER-ZINC BATTERIES;NICKEL-ZINC BATTERIES; ZINC-MANGANESE BATTERIES;ZINC;ZINC OXIDES; MAGNESIUM OXIDES;POTASSIUM HYDROXIDES;ANODES; FABRICATION;ELECTRIC BATTERIES;HYDROXIDES; ELECTROLYTES;PERFORMANCE

1037 SECONDARY ZINC--HALOGEN BATTERY. (to Unigate Ltd.). German(FRG) Patent 2,440,619. 6 Mar 1975. Filed date 24 Aug 1973. 21p.
METAL-GAS BATTERIES;ZINC-CHLORINE BATTERIES; ANODES;DESIGN

1038 MOLTEN SALT BATTERIES. Yamasaki, H.; Hayashi, T.; Yamane, T.; Kuze, K. (to Matsushita Electric Industrial Co., Ltd.). Japanese Patent 21,224. 6 Mar 1975. Filed date 28 Jun 1973. 4p.
Patent; Ca/LiCl--KCl ($Na_2CO_3$)/Ni, small voltage fluctuation. METAL-METAL BATTERIES; CALCIUM;NICKEL;LITHIUM;CHLORIDES;POTASSIUM CHLORIDES;MOLTEN SALTS;ELECTROLYTES;SODIUM CARBONATES;CALCIUM COMPOUNDS;CHROMATES;ELECTRIC POTENTIAL

1039 MOLTEN SALT BATTERIES. Yamasaki, H.; Yamane, T.; Ohmukai, Y.; Kuze, K. (to Matsushita Electric Industrial Co., Ltd.). Japanese Patent 21,223. 6 Mar 1975. Filed date 28 Jun 1973. 5p.
Patent; Ca/LiCl--KCl($K_2SO_4$)/Ni, small voltage fluctuation. METAL-METAL BATTERIES; CALCIUM;NICKEL;LITHIUM CHLORIDES;POTASSIUM CHLORIDES;POTASSIUM SULFATES;MOLTEN SALTS; ELECTROLYTES;ELECTRIC POTENTIAL;CALCIUM COMPOUNDS;CHROMATES

1040 ZINC--CHLORINE SECONDARY BATTERY. (to Unigate Ltd.). German(FRG) Patent 2,440,620. 27 Feb 1975. Filed date 24 Aug 1973. 7p.
Patent; $ZnCl_2$ electrolyte. ZINC-CHLORINE BATTERIES;ELECTROLYTES;ZINC CHLORIDES;CHEMICAL PREPARATION;DESIGN;DENDRITES

1041 RECHARGEABLE ZINC--CHLORINE BATTERY. (to Unigate Ltd.). German(FRG) Patent 2,440,621. 27 Feb 1975. Filed date 24 Aug 1973. 7p.
Patent; C--metal cathode semipermeable ion-selective separator foils. ZINC-CHLORINE BATTERIES;DESIGN;CARBON;METALS;CATHODES;BATTERY SEPARATORS

1042 ZINC ALKALINE BATTERIES. Peters, R.W. (to ESB Inc.). British Patent 1,385,467. 26 Feb 1975. Filed date 30 Jul 1973. 4p.
Patent; storage at 130°F. ELECTRIC BATTERIES; ZINC;TITANIUM OXIDES;LIFETIME;PERFORMANCE; STORAGE;MEDIUM TEMPERATURE

1043 BATTERY WITH ALKALINE ELECTROLYTE. (to Union Carbide Corp.). Australian Patent 320,769. 25 Feb 1975. Filed date 25 Aug 1972. 8p.
Wetting prevented by covering with polyaminoamide;patent. ELECTRIC BATTERIES; POLYAMIDES;WETTABILITY;ELECTROLYTES;BASES

1044 DRY-CHARGED LEAD STORAGE BATTERY. Mao, G.W.; Sabatino, A.; Rao, P. (to Gould, Inc.). GE 2,431,208. 20 Feb 1975. Filed date 09 Jul 1973. 68p.
LEAD-ACID BATTERIES;CHEMICAL PREPARATION; FABRICATION

1045 SEALED STORAGE BATTERIES. Morioka, Y. (to Sanyo Electric Co., Ltd.). Japanese Patent 16,045. 20 Feb 1975. Filed date 18 Jun 1973. 3p.
Patent; inhibition of gas generation by Pb or Sb addition. BATTERY SEPARATORS;NICKEL-CADMIUM BATTERIES;CHEMICAL PREPARATION;SEALS; LEAD;ANTIMONY;ADDITIVES;PERFORMANCE;GASES; EMISSION

1046 ZINC--AIR FUEL CELL. Krenn, M.; Hadusfalvi, I.; Kadar, E.; Kulcsar, S. (to Interag Rt.; Texelektro Textil- es Elektronika Ipari Szovetkezet). German(FRG) Patent 2,435,800. 20 Feb 1975. Filed date 2 Aug 1973. 16p.
ZINC-AIR BATTERIES;DESIGN;PERFORMANCE;OXYGEN; INORGANIC ACIDS;HYDROXIDES;SILVER;CATALYSTS

1047 NICKEL HYDROGEN CELL. Dunlop, J.D.; Giner, J.; Van Ommering, G.; Stockel, J.F. (to Communications Satellite Corp.). US Patent 3,867,199. 18 Feb 1975. Filed date 05 Jun 1972. 9p.
Patent; pressurized to 100 psi. NICKEL-HYDROGEN BATTERIES;NICKEL HYDROXIDES;MEDIUM PRESSURE;NICKEL;PLATINUM;PALLADIUM; POLYPROPYLENE;POTASSIUM HYDROXIDES;DESIGN; SAFETY

1048 CELL CASING WITH A HERMETICAL MECHANICAL SEAL AND A HERMETICALLY SEALED SODIUM--SULFUR CELL. Breiter, M.W.; Mitoff, S.P.; Powers, R.W. (to General Electric Co.). US Patent 3,946,751. 18 Feb 1975. vp.
A cell casing with a hermetic mechanical seal comprising a ceramic ring, an inner casing of a solid sodium ion-conductive material with one open end, and a glass seal sealing a portion of the outer wall of the inner casing adjacent its open end within and to the ceramic ring is described. A first outer casing portion has at least one open end and a flange at the open end. The first outer casing portion surrounds the inner casing and is spaced away from it, the flange of the first outer casing portion being adjacent the ceramic ring. A second outer casing portion has at least one open end and a flange at the open end positioned with the flange adjacent the ceramic ring, whereby the second outer casing portion is spaced from, and extends in an opposite direction to, the first outer metallic casing portion. The first and second outer casing portions are joined to the ceramic ring by a hermetic mechanical seal, thereby forming a

continuous outer cell casing. The hermetic mechanical seal is insulated electrically from the outer casing portions. The hermetic mechanical seal comprises a pair of retainer rings, each retainer ring of the pair of retainer rings being positioned between the ceramic ring and an adjacent flange of an associated outer casing portion. There is a pair of open edge metallic sealing rings, each of the pair of sealing rings being positioned outside of and spaced from the associated retainer ring. A retaining collar is positioned around each outer casing portion and in contact with the opposite surface of the outer casing portion flange. Each collar is provided with at least a pair of apertures, and the collars are positioned so that the respective apertures of the associated collars are aligned. A threaded fastener passes through each of the pairs of associated apertures. The threaded fasteners are thus positioned tightly and form a hermetic seal.

1049 LEAKPROOF BATTERY. Krey, W. (to Varta Batterie A.-G.). GE 2,335,369. 13 Feb 1975. Filed date 12 Jul 1973. 11p.
Separation of small dried particles of anion and cation exchanges held together by binder; patent. ELECTRIC BATTERIES;DESIGN;BATTERY SEPARATORS;ION EXCHANGE MATERIALS;BINDERS

1050 ALKALINE MANGANESE DIOXIDE BATTERY. Uetani, Y.; Ishikawa, Y. (to Hitachi Makuseru Co., Ltd.). Japanese Patent 13,851. 13 Feb 1975. Filed date 12 Jun 1973. 3p.
Patent; contains water-repelling agent for improved performance. ZINC-MANGANESE BATTERIES; HYDROXIDES;MANGANESE OXIDES;GRAPHITE;PARAFFIN; CATHODES;PERFORMANCE;FABRICATION

1051 CELL WITH LIGHT METAL ANODE. Fukuda, M.; Iijima, T.; Kondo, S. (to Matsushita Electric Industrial Co., Ltd.). JA 03,846. 12 Feb 1975. Filed date 02 Jun 1969. 3p.
Halide cathode, nonaqueous Cl-containing electrolyte;patent. METAL-NONMETAL BATTERIES; LITHIUM;SODIUM;CALCIUM;MAGNESIUM;ALUMINIUM; HALIDES;CHEMICAL PREPARATION;CATHODES;CARBONIC ACID DERIVATIVES;LITHIUM CHLORIDES;ALUMINIUM CHLORIDES;FABRICATION

1052 SECONDARY BATTERY. Fukuda, M.; Iijima, T.; Kondo, S. (to Matsushita Electric Industrial Co., Ltd.). Japanese Patent 3,845. 12 Feb 1975. Filed date 23 May 1969. 3p.
Patent; Li, Na, Ca, or Al/propylene carbonate with I-/Ag, Ni, Cu, or Pb halide. METAL-NONMETAL BATTERIES;DESIGN;LITHIUM;SODIUM; CALCIUM;ALUMINIUM;SILVER COMPOUNDS;NICKEL COMPOUNDS;COPPER COMPOUNDS;LEAD COMPOUNDS; HALIDES;IODINE IONS;ELECTROLYTES;LEAD CHLORIDES; CARBON;CARBONIC ACID ESTERS;LITHIUM COMPOUNDS; PERCHLORATES;LITHIUM IODIDES

1053 ALKALINE MANGANESE--ZINC BATTERY. Naumenko, V.A.; Lyapuntsova, T.G.; Lidorenko, N.S.; Lebedeva, E.S.; Penkova, L.F.; Aleshin, V.N. British Patent 1,384,030. 12 Feb 1975. Filed date 24 Aug 1973. 5p.
The battery described consisted of flat electrodes assembled in a pack. Cathodes were enclosed in perforated metal frames, while the anodes were metal plates coated with zinc. The batteries had capacities of about 2000 Ah and power--weight ratios of 100 Wh/kg and were resistant to shock and vibration. (RWR)

1054 LEAD STORAGE BATTERY. Kawase, T.; Tanabe, Y.; Sano, I.; Sakurai, T. (to Matsushita Electric Industrial Co., Ltd.). Japanese Patent 12,538. 8 Feb 1975. Filed date 6 Apr 1973. 5p.
Patent; performance after 55,000 km with Pb--2.5 Sb--0.8 percent As cathode and Pb--0.09 percent Ca anode. LEAD-ACID BATTERIES; ELECTRODES;DESIGN;GRIDS;LEAD BASE ALLOYS; PHYSICAL PROPERTIES;PERFORMANCE;COMPARATIVE EVALUATIONS;AUTOMOBILES;CATHODES;ANTIMONY ALLOYS;ARSENIC ADDITIONS;ANODES;CALCIUM ADDITIONS

1055 FILLING OF BATTERY PLATE TUBULES WITH ACTIVE MASS. Niklas, H. (to Varta Batterie AG). German(FRG) Patent 2,337,258. 6 Feb 1975. Filed date 21 Jul 1973. 9p.
ELECTRIC BATTERIES;LEAD-ACID BATTERIES; HYDROXIDES;ELECTROLYTES;PLATES;FABRICATION

1056 MAINTENANCE-FREE LIGHT LEAD--ACID BATTERY. Ruben, S. German(FRG) Patent 2,434,193. 6 Feb 1975. Filed date 16 Jul 1973. 18p.
LEAD-ACID BATTERIES;DESIGN;NICKEL;TITANIUM; SUPPORTS;STAINLESS STEELS;GELS;TITANIUM OXIDES; TITANIUM SULFATES

1057 SUBMERSIBLE POWER SUPPLIES. Hales, T.J. Electron. Power; 21: No. 2, 98-99(6 Feb 1975).
One of the key problems in developing undersea wellheads is the availability of power supplies for pumping and instrumentation purposes. The obvious power source for this purpose is a rechargeable battery. The major problem to be overcome in operating any battery under water is that hydrogen and oxygen are evolved while the battery is on charge. The solution was provided by the electrochemical properties of the nickel-cadmium alkaline battery. Batteries do not normally produce gas during the early part of their charge cycle, and, irrespective of the type of battery, it is possible to charge a battery to around 60% of its nominal capacity before gassing commences. Further, it is also possible to operate a nickel-cadmium battery permanently in a low state of charge without any permanent loss of capacity or permanent damage to the battery. Charging is normally achieved by applying a regulated voltage of 1.37v per cell, which is sufficient to achieve a reasonable capacity without any evolution of gas. Pressure-balanced batteries in which the specially developed battery container is flooded with a light oil have been developed. The oil used has a specific gravity of 0.87, and therefore floats on top of the alkaline electrolyte. The cell vents are opened, the cells are topped up with oil until they overflow and the space around the cells in the battery container is filled with oil. The lid of the battery container is then fitted, and more oil is added through a filler plug in the lid itself until all air is excluded from the battery. When the battery is submerged there is a small initial loss of oil until the pressure of the water balances the oil.

1058 METHOD OF FILLING TUBES OF ACCUMULATOR PLATES WITH ACTIVE MASS. Niklas, H. (to Varta Batteries A.G.). German(FRG) Patent 2,337,258/A/. 6 Feb 1975. 9p. (In German).
1 fig. Available from Dt. Patentamt, Muenchen (FRG).
The invention deals with a method of filling tubes of accumulator plates with active mass. The active mass is introduced into the tubes by

means of inserted rotating helices and sealed. These rotating helices are continuously removed from the tubes in the filling process. A filling cassette designed with a filling funnel is used for packing, the rotating transport helices are displaceably arranged along the filling axes of the funnel.

1059 AIRTIGHT STORAGE BATTERY. Kloss, A.I.; Tsenter, B.I.; Novoselova, V.D. (to All-Union Scientific-Research Storage-Battery Institute). UR 459,821. 05 Feb 1975. Filed date 25 May 1964.
Cd anode, O cathode; patent. METAL-GAS BATTERIES;CADMIUM;OXYGEN;HYDROXIDES;DESIGN; CATHODES

1060 BATTERIES INCORPORATING WATER SCAVENGERS. Casey, J.E., Jr.; Chireau, R.F. (to Yardney International Corp.). US Patent 3,864,168. 4 Feb 1975. Filed date 22 Mar 1974. 6p.
Patent; Li, Na, or Zn/propylene carbonate + $LiClO_4$/graphite fluoride. METAL-NONMETAL BATTERIES;DESIGN;LITHIUM;SODIUM;ZIRCONIUM; CARBONIC ACID ESTERS;LITHIUM COMPOUNDS; PERCHLORATES;ZEOLITES;CELLULOSE;WATER; SCAVENGING;SHEETS;CARBON FLUORIDES

1061 NONAQUEOUS BATTERY USING CHALCOGENIDE ELECTRODE. Broadhead, J.; Di Salvo, F.J., Jr.; Trumbore, F.A. (to Bell Telephone Labs., Inc.). US Patent 3,864,167. 4 Feb 1975. Filed date 19 Apr 1973. 5p.
METAL-NONMETAL BATTERIES;DESIGN;CATHODES; CARBONIC ACID ESTERS;LITHIUM COMPOUNDS; PERCHLORATES;NIOBIUM SELENIDES;TANTALUM SELENIDES;NIOBIUM SULFIDES;TANTALUM SULFIDES; TITANIUM SULFIDES

1062 BATTERY WITH ALKALINE ELECTROLYTE. Bonnaterre, R. (to Societe des Accumulateurs Fixes et de Traction). French Patent 2,236,283. 31 Jan 1975. Filed date 22 Jun 1973. 6p.
Patent; $Ni(OH)_2$/tetraalkylammonium hydroxide/ $Cd(OH)_2$; most efficient below 55°. NICKEL-CADMIUM BATTERIES;NICKEL HYDROXIDES;CADMIUM HYDROXIDES;QUATERNARY COMPOUNDS;MEDIUM TEMPERATURE;DESIGN

1063 NICKEL--ZINC ALKALINE CELL. Ohhira, T.; Sekido, S.; Ikeda, Y.; Yokoyama, T. (to Matsushita Electric Industrial Co., Ltd.). Japanese Patent 9,727. 31 Jan 1975. Filed date 1 Jun 1973. 3p.
NICKEL-ZINC BATTERIES;NICKEL OXIDES;ZINC; HYDROXIDES;GASES;CATALYSTS;DESIGN;SAFETY;VALVES; PERFORMANCE;POTASSIUM HYDROXIDES;LITHIUM HYDROXIDES

1064 SEALED NICKEL--ZINC STORAGE BATTERY. Sekido, S.; Ohhira, T.; Yokoyama, T.; Ikeda, Y. (to Matsushita Electric Industrial Co., Ltd.). Japanese Patent 9,725. 31 Jan 1975. Filed date 31 May 1973. 4p.
NICKEL-ZINC BATTERIES;SEALS;POTASSIUM HYDROXIDES;LITHIUM;GASES;CATALYSTS;FABRICATION; DESIGN

1065 STORAGE BATTERY WITH LITHIUM ELECTRODE. (to Varta Batterie AG). French Patent 2,236,284. 31 Jan 1975. Filed date 7 Jul 1973. 6p.
LITHIUM-SULFUR BATTERIES;ELECTROLYTES;DESIGN; ALKANES;CARBOXYLIC ACID ESTERS;BORON FLUORIDES; LITHIUM FLUORIDES;LITHIUM CHLORIDES;ALUMINIUM CHLORIDES

1066 AIRTIGHT ALKALINE NICKEL--CADMIUM STORAGE BATTERY CONTAINING A GAS ABSORBER. Tsenter, B.I.; Ten'kovtsev, V.V.; Nikol'skii, V.A.; Davydova, S.V. UR 458,907. 30 Jan 1975. Filed date 24 Apr 1973. 116p.
NICKEL-CADMIUM BATTERIES;GASES;DESIGN

1067 ELECTRIC BATTERY. Hollis, K.L.; Hemming, G.H. (to Chloride Alcad Ltd.). German(FRG) Patent 2,432,312. 30 Jan 1975. Filed date 6 Jul 1973. 10p.
Patent; plates connected to common bridge by spot welding. ELECTRIC BATTERIES;FABRICATION; PLATES;WELDING

1068 REGULATING THE GENERATION OF CHLORINE FROM CHLORINE HYDRATE FOR METAL--CHLORINE BATTERIES. Symons, P.C. (to Energy Development Associates). German(FRG) Patent 2,431,406. 30 Jan 1975. Filed date 2 Jul 1973. 19p.
METAL-GAS BATTERIES;ZINC-CHLORINE BATTERIES; LITHIUM-CHLORINE BATTERIES;CHLORINE;GAS FLOW; DESIGN;HYDRATES

1069 RECHARGEABLE ELECTRIC BATTERY WITH LITHIUM ANODE. (to Compagnie Generale d'Electricite). British Patent 1,382,339. 29 Jan 1975. Filed date 30 Apr 1971. 3p.
Patent; CuS catholyte, LiI separator. LITHIUM;ANODES;ELECTRIC BATTERIES;COPPER SULFIDES;LITHIUM IODIDES;ELECTRIC POTENTIAL; PERFORMANCE;TEFLON;DESIGN

1070 SECONDARY CELLS WITH A LITHIUM ANODE AND SALT MELT. Heredy, L.A.; McCoy, L.R. (to Rockwell International). German(FRG) Patent 2,427,949. 23 Jan 1975. Filed date 11 Jun 1973. 23p.
Patent; Li or alloy/$Li^+$ electrolyte/ transition metal chalcogenide or oxide ($FeS_2$, $Cr_2S_3$, CuSe; high energy density. METAL-NONMETAL BATTERIES;HIGH TEMPERATURE;LITHIUM-SULFUR BATTERIES;LITHIUM COMPOUNDS;LITHIUM; LITHIUM ALLOYS;MOLTEN SALTS;IRON SULFIDES; CHROMIUM SULFIDES;COPPER SELENIDES; CHALCOGENIDES;OXIDES;DESIGN

1071 LITHIUM--SULFUR BATTERY. Lauck, H. (to Varta Batterie AG). German(FRG) Patent 2,334,660. 23 Jan 1975. Filed date 7 Jul 1973. 7p.
Patent; button-type, cell, electrolyte of dimethyl carbonate, 1,2-dimethoxyethane, $BF_3$, and $LiBF_4$. LITHIUM-SULFUR BATTERIES;DESIGN; PERFORMANCE;BORON FLUORIDES;LITHIUM FLUORIDES; CARBONIC ACID ESTERS;ETHERS

1072 SECONDARY BATTERIES WITH MOLTEN ALKALI METAL ANODES. Werth, J. (to ESB Inc.). British Patent 1,381,448. 22 Jan 1975. Filed date 26 Sep 1972. 6p.
Patent; 50 to 150 W-hr/lb, $Na/NaAlCl_4/C$. SODIUM;SODIUM CHLORIDES;ALUMINIUM CHLORIDES; CARBON;ACTIVATED CARBON;CHARCOAL;METAL-NONMETAL BATTERIES;DESIGN;PERFORMANCE

1073 LEAD--ACID BATTERY WITH RESEALABLE VENT VALVE. O'Sullivan, T.D. (to Bell Telephone Labs., Inc., Murray Hill, NJ). US Patent 3,861,965. 21 Jan 1975. Filed date 7 Sep 1972. 6p.
LEAD-ACID BATTERIES;VENTS;DESIGN;VALVES; AUTOMOBILES;POWER SUPPLIES

1074 NICKEL--CADMIUM ALKALINE BATTERY. Tsygankov, M.S.; Kosholkin, V.N.; Bityutskaya, N.A.; Malandin, O.G. (to Scientific-Research Institute of Chemical Sources of Current). French Patent 2,234,670. 17 Jan 1975. Filed date 22 Jun 1973. 11p.
NICKEL-CADMIUM BATTERIES;DESIGN;CADMIUM OXIDES

1075 GENERATING ELECTRICAL OUTPUT BY ELECTROCHEMICAL OXIDATION. Doniat, D.; Bugnet, B.; Porta, A. (to Battelle Memorial Inst.). German(FRG) Patent 2,431,287. 16 Jan 1975. Filed date 28 Jun 1973. 13p.
Patent; system with 2 filters, one heated. ZINC-AIR BATTERIES;HYDROXIDES;BASES; ELECTROLYTES;DESIGN;FILTERS

1076 AIRTIGHT ALKALINE STORAGE BATTERY. Tsenter, B.I.; Kloss, A.I. (to All-Union Scientific-Research Storage-Battery Institute). UR 457,126. 15 Jan 1975. Filed date 25 May 1964. 103p.
Ag/$H_2$;patent. METAL-GAS BATTERIES;SILVER; HYDROGEN;BASES;DESIGN

1077 ELECTRICAL ENERGY STORAGE BATTERY MEANS. Cole, C.F. Jr. (to Continental Oil Co.). US Patent 3,936,318. 13 Jan 1975. vp.
An improved electrical energy storage battery consists of the following; a case; at least two porous electrolyte containers positioned within the case; a solid hydrogel positioned within the case and between the electrolyte containers, the hydrogel containing an effective amount of an electron transferring agent to render it conductive; at least one anode positioned within at least one of the electrolyte containers; at least one cathode positioned within at least one of the electrolyte containers; a second solid hydrogel positioned within the container for the cathode, the gel being saturated with a compound selected from the group consisting of zinc chloride, zinc oxide, cadmium chloride, and cadmium oxide to render the gel conductive; and, a third solid hydrogel positioned within the container for the anode, the gel being saturated with a compound selected from the group consisting of chromium chloride, chromium oxide, and alkali metal containing chromate salts to render the gel conductive.

1078 BATTERY ASSEMBLY. Decker, E.; Janke, A. (to Grace G.m.b.H.). German(FRG) Patent 2,332,546. 9 Jan 1975. Filed date 27 Jun 1973. 20p.
Patent; plates and separators enclosed by continuous strip of resin or thermoplastic. ELECTRIC BATTERIES;DESIGN;RESINS;THERMOPLASTICS

1079 LITHIUM IODINE BATTERY HAVING IMPROVED ENERGY DENSITY. Mead, R.T.; Greatbach, W.; Rudolph, F.W. US Patent 3,944,433. 9 Jan 1975. vp.
A lithium--iodine cell comprises a lithium anode (including a lithium element and an anode current collector operatively associated with the lithium element) and a cathode comprising an iodine element, a charge transfer complex of an organic donor component and iodine, and a cathode current collector operatively positioned between the iodine element and the charge transfer complex and operative to diffuse iodine from the iodine element to the charge transfer complex.

1080 ALKALINE CELL USING A NICKELIC HYDROXIDE CATHODE. Hayashi, Y.; Takeuchi, K. (to Yuasa Hardware Co., Ltd.). Japanese Patent 1,326. 8 Jan 1975. Filed date 11 May 1973. 3p.
Patent; $Ni(OH)_3$ cathode, catholyte containing $NaClO_3$ and KOH, analyte containing $Na_2S$ and KOH. ELECTRIC BATTERIES;NICKEL HYDROXIDES;POTASSIUM HYDROXIDES;SODIUM SULFIDES; SODIUM COMPOUNDS;CHLORATES;PERFORMANCE

1081 ENCLOSED ELECTRICAL ENERGY STORAGE DEVICE WITH HALOGEN ABSORBING MEANS. Hart, T.G. (to Occidental Energy Development Co., Madison Heights, MI). US Patent 3,859,142. 7 Jan 1975. Filed date 20 Mar 1972. 4p.
Patent; halogen oxidant. ELECTRIC-POWERED VEHICLES;METAL-GAS BATTERIES;METAL-NONMETAL BATTERIES;DESIGN;FLUORINE;CHLORINE;BROMINE;ZINC-CHLORINE BATTERIES;LITHIUM-CHLORINE BATTERIES

1082 AUTOMATICALLY ACTIVATABLE BATTERY. Koethe, H.K.; Schneider, R. (to Varta Batterie AG). German(FRG) Patent 2,329,362. 2 Jan 1975. Filed date 8 Jun 1973. 10p.
Patent; pressurized gas. ELECTRIC BATTERIES; DESIGN

1083 LEAD--ACID BATTERIES. Ponsford, J.M. (to Lucas, Joseph, (Batteries) Ltd.). South African Patent 257. 2 Jan 1975. Filed date 18 Jan 1973. 9p.
LEAD-ACID BATTERIES;DESIGN;SEALS;PLATES; CONTAINERS

1084 BATTERIES: PROSPECTS FOR ELECTRIC VEHICLES. Brooman, E.W.; Clifford, J.E.; Semones, D.E. (Battelle Columbus Lab., OH). Automot. Eng. (N.Y.); 83: No. 1, 30-35(Jan 1975).
A battery with both high specific power and with high specific energy is impossible to manufacture. Therefore, hybrid systems are often employed in storage battery vehicles. These use batteries with high specific power to give higher speeds and a second battery with high specific energy to give better range. The authors discuss alternatives to the lead-acid battery.

1085 MICROSTRUCTURAL CONTROL IN LEAD ALLOYS FOR STORAGE BATTERY APPLICATION. Perkins, J.; Edwards, G.R. (Naval Postgraduate School, Monterey, CA). J. Mater. Sci.; 10: No. 1, 136-158(Jan 1975).
The role of alloying and thermomechanical processing in direct microstructural control in lead-base storage battery alloys is reviewed. Strength, corrosion, and electrochemical correlations are discussed for conventional and emerging lead alloy systems.

1086 PILOT PLANT STUDIES ON THE HYDROMETALLURGICAL TREATMENT OF WASTE LEAD BATTERY PASTE USING DIETHYLENETRIAMINE. Lyakov, N.; Nikolov, T. (Vissh. Khim. Tekhnol. Inst., Sofia, Bulgaria). Metalurgiya (Sofia); 30: No. 1, 17-19(1975).
LEAD-ACID BATTERIES;LEAD;RECOVERY;EXTRACTION; WASTES;WASTE MANAGEMENT;PILOT PLANTS;AMINES

1087 COPPER SULFIDE ELECTRODES IN ORGANIC ELECTROLYTE SOLUTIONS. I. INCREASE OF THE SULFIDE CONTENT IN ELECTROLYTES BY POLYETHERS AND LEWIS ACIDS. Eichinger, G.; Fritz, H.P. (Anorg.-Chem. Lab., Tech. Univ. Muenchen,

Munich, Germany). J. Electroanal. Chem. Interfacial Electrochem.; 58: No. 2, 357-67(1975).
Li/CuS. METAL-NONMETAL BATTERIES;LITHIUM; COPPER SULFIDES;ELECTROLYTES;ORGANIC COMPOUNDS; LEWIS ACIDS;POLYETHYLENE GLYCOLS;ORGANIC SOLVENTS;ELECTROCHEMISTRY;CHEMICAL REACTIONS; ELECTRODES

1088 NEW BATTERIES ARE COMING. Iammartino, N.R. Chem. Eng. (N.Y.); 82: No. 2, 48-50(1975).
Developmental projects; no refs. ELECTRIC BATTERIES;REVIEWS

1089 RELATING STRUCTURAL VARIABLES OF POROUS ELECTRODES. Katan, T.; Bauman, H.F. (Lockheed Palo Alto Res. Lab., Palo Alto, CA). J. Electrochem. Soc.; 122: No. 1, 77-80(1975).
Method gives specific surface area. CATHODES; ELECTRIC BATTERIES;ELECTRODES;SIZE;SHAPE; POROSITY;LENGTH;SILVER;SILVER OXIDES;SILVER-ZINC BATTERIES;SILVER-CADMIUM BATTERIES;NICKEL

1090 CHEMICAL INVESTIGATIONS OF LITHIUM--SULFUR CELLS. Birk, J.R.; Steunenberg, R.K. (Chem. Eng. Div., Argonne Natl. Lab., Argonne, IL). Adv. Chem. Ser.; 140 (New Uses Sulfur, Symp., 1974): 186-202(1975).
LITHIUM-SULFUR BATTERIES;OFF-PEAK ENERGY STORAGE;HIGH TEMPERATURE;LITHIUM CHLORIDES; POTASSIUM CHLORIDES;ELECTROCHEMISTRY;CATHODES

1091 BATTERIES AND FUEL CELLS. pp 127-138 of Interfacial electrochemistry: an experimental approach. Reading, MA; Addison-Wesley Publishing Co., Inc. (1975).
ELECTRIC BATTERIES;FUEL CELLS;ELECTRODES; ELECTROLYTES;ELECTROCHEMISTRY

1092 SODIUM/SULPHUR BATTERIES FOR RAIL TRACTION. Sudworth, J.L. (British Railways Board Research and Development Division, Berby, Eng.). pp 616-620 of Tenth intersociety energy conversion engineering conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1975).
From 10. intersociety energy conversion engineering conference; Newark, Delaware, USA (17 Aug 1975).
See CONF-750812--.
Development studies. SODIUM-SULFUR BATTERIES; ELECTRIC-POWERED VEHICLES;TRAINS;DESIGN; CATHODES;ELECTROLYTES;CERAMICS

1093 PROGRESS IN THE DEVELOPMENT OF THE HOLLOW FIBER SODIUM--SULFUR SECONDARY CELL. Levine, C.A. (Dow Chemical, Walnut Creek, CA). pp 621-623 of Tenth intersociety energy conversion engineering conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1975).
From 10. intersociety energy conversion engineering conference; Newark, Delaware, USA (17 Aug 1975).
See CONF-750812--.
Fine glass fibers as electrolyte. SODIUM-SULFUR BATTERIES;GLASS;FIBERS;ELECTROLYTES; PERFORMANCE;FAILURES

1094 SODIUM--SULFUR TEST CELL UTILIZING A BETA-ALUMINA FLAT-PLAT SEPARATOR. Marcoux, L.S.; Sayano, R.R.; Seo, E.T.; Silverman, H.P. (TRW Systems Group, TRW Inc., Redondo Beach, CA). pp 624-626 of Tenth intersociety energy conversion engineering conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1975).
From 10. intersociety energy conversion engineering conference; Newark, Delaware, USA (17 Aug 1975).
See CONF-750812--.
OFF-PEAK ENERGY STORAGE;SODIUM-SULFUR BATTERIES;GEOMETRY;DESIGN;FABRICATION;ALUMINIUM OXIDES

1095 ESB-SOHIO CARB TEX/SUP R/ MOLTEN SALT CELL. Schaefer, J.C.; Noveske, T.M.; Thompson, J.S.; Profeta, B. (ESB Inc., Yardley, PA). pp 649-650 of Tenth intersociety energy conversion engineering conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1975).
From 10. intersociety energy conversion engineering conference; Newark, Delaware, USA (17 Aug 1975).
See CONF-750812--.
Li--Al/LiCl--KCl/C. METAL-NONMETAL BATTERIES; ALUMINIUM ALLOYS;LITHIUM ALLOYS;LITHIUM CHLORIDES;POTASSIUM CHLORIDES;CARBON;ELECTRIC-POWERED VEHICLES;PERFORMANCE

1096 NICKEL--HYDROGEN SECONDARY BATTERY. Klein, M. (Energy Research Corp., Danbury, CT). pp 803-806 of Tenth intersociety energy conversion engineering conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1975).
From 10. intersociety energy conversion engineering conference; Newark, Delaware, USA (17 Aug 1975).
See CONF-750812--.
Design and testing of cells and complete batteries. NICKEL-HYDROGEN BATTERIES;SATELLITES; DESIGN;LIFETIME;PERFORMANCE TESTING

1097 NICKEL--HYDROGEN AS AN ALTERNATIVE TO LEAD--ACID AND NICKEL--CADMIUM SYSTEMS IN NON-SPACE APPLICATIONS. Miller, L.E. (Eagle-Picher Industries, Inc., Joplin, MO). pp 807-810 of Tenth intersociety energy conversion engineering conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1975).
From 10. intersociety energy conversion engineering conference; Newark, Delaware, USA (17 Aug 1975).
See CONF-750812--.
System with reduced costs. NICKEL-HYDROGEN BATTERIES;DESIGN;COST

1098 ECONOMIC AND TECHNICAL ASPECTS OF THE C.G.E. ZN--AIR VEHICLE BATTERY. Appleby, A.J.; Pompon, J.P.; Jacquier, M. (Centre de Recherches, Marcoussis, France). pp 811-816 of Tenth intersociety energy conversion engineering conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1975).
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See CONF-750812--.
Zn powder; rechargeable electrically in or outside of vehicle. ELECTRIC-POWERED VEHICLES; ZINC-AIR BATTERIES;DESIGN;ZINC;POWDERS; AUTOMOBILES;PLANNING

1099 ZINC--NICKEL OXIDE SECONDARY BATTERY. McCoy, L.R. (Rockwell International, Canoga Park, CA). pp 1131-1134 of Tenth intersociety energy conversion engineering conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1975).
From 10. intersociety energy conversion engineering conference; Newark, Delaware, USA

(17 Aug 1975).
See CONF-750812--.
Rotating shutter--separator to stir electrolyte. NICKEL-ZINC BATTERIES;DESIGN; ELECTRIC-POWERED VEHICLES;OFF-PEAK ENERGY STORAGE;ELECTRODES;MIXING;ELECTROLYTES

1100 ZINC--POLYBROMIDE BATTERIES. Walsh, M.; Walsh, F.; Crouse, D. (Eco-Control, Inc., Cambridge, MA). pp 1141-1142 of Tenth intersociety energy conversion engineering conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1975).
From 10. intersociety energy conversion engineering conference; Newark, Delaware, USA (17 Aug 1975).
See CONF-750812--.
METAL-NONMETAL BATTERIES;ZINC;BROMINE; PERFORMANCE

1101 NICKEL--HYDROGEN BATTERY SYSTEM DEVELOPMENT. Patterson, R.E.; Sparks, R.H. (TRW Systems Group, Redondo Beach, CA). pp 1281-1290 of Tenth intersociety energy conversion engineering conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1975).
From 10. intersociety energy conversion engineering conference; Newark, Delaware, USA (17 Aug 1975).
See CONF-750812--.
SATELLITES;NICKEL-HYDROGEN BATTERIES; PERFORMANCE;DESIGN;ELECTRIC POTENTIAL

1102 ENGINEERING DEVELOPMENT AND QUALIFICATION OF LARGE SEALED NICKEL--CADMIUM BATTERIES FOR LONG-DURATION SPACE MISSIONS. Kinsey, R.H. (Lookheed Missiles and Space Co., Inc., Sunnyvale, CA); Gordon, D. pp 1291-1296 of Tenth intersociety energy conversion engineering conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1975).
From 10. intersociety energy conversion engineering conference; Newark, Delaware, USA (17 Aug 1975).
See CONF-750812--.
NICKEL-CADMIUM BATTERIES;SPACE VEHICLES; DESIGN;PERFORMANCE TESTING

1103 BATTERY DESIGN AND CELL TESTING FOR ELECTRIC-VEHICLE PROPULSION. Schertz, W.W.; Chilenskas, A.A.; Kolba, V.M. (Argonne National Lab., IL). pp 634-641 of Tenth intersociety energy conversion engineering conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1975).
From 10. intersociety energy conversion engineering conference; Newark, Delaware, USA (17 Aug 1975).
See CONF-750812--.
Li--Al/LiCl--KCl/Fe sulfides. ELECTRIC-POWERED VEHICLES;LITHIUM-SULFUR BATTERIES; LITHIUM ALLOYS;ALUMINIUM ALLOYS;LITHIUM CHLORIDES;POTASSIUM CHLORIDES;IRON SULFIDES; HIGH TEMPERATURE;PERFORMANCE TESTING;DESIGN; SPECIFICATIONS

1104 OVERVIEW OF THE SODIUM--SULFUR BATTERY. Weiner, S.A. (Ford Motor Co., Dearborn, MI). New York; SAE (1975). 8p.
SODIUM-SULFUR BATTERIES;ELECTROLYTES; CERAMICS;CATHODES;TESTING;REVIEWS

1105 RECENT IMPROVEMENTS IN HIGH PERFORMANCE SECONDARY BATTERIES FOR USE ON OFFSHORE PLATFORMS. Snyder, D.N. pp 127-33 of Offshore technology conference. Volume II. (1975).
NICKEL-CADMIUM BATTERIES;PERFORMANCE; ELECTRIC BATTERIES;POWER SUPPLIES;OFFSHORE DRILLING

1106 SECONDARY BATTERIES WITH NONAQUEOUS ELECTROLYTES. PRESENT STATE AND LONG-TERM OUTLOOK. Quobex, J.; Gabano, J.P. (Soc. Acumulateurs Fixes et Traction, Romainville, Fr.). Rev. Gen. Electr.; 84: No. 6, 491-6(1975).
ELECTRIC BATTERIES;FORECASTING;REVIEWS

1107 EVALUATION OF THE USE OF BIOLOGICAL INDICATORS IN AN ATMOSPHERIC LEAD SURVEY. Ratcliffe, J.M. (Pollut. Res. Unit, Univ. Manchester, England). Atmos. Environ.; 9: No. 6-7, 623-9(1975).
Moss and grass samples taken near factory. LEAD-ACID BATTERIES;FABRICATION;LEAD;AIR;EARTH ATMOSPHERE;GRASS;MOSSES;MONITORING;CHEMICAL EFFLUENTS

1108 STORAGE OF ELECTRIC ENERGY. Kozawa, A. (Middleburg Heights, Ohio). Kagaku Kogyo; 26: No. 8, 826-30(1975).
ZINC-MANGANESE BATTERIES;OFF-PEAK ENERGY STORAGE;ADDITIVES;CURRENT DENSITY;LEAD SULFATES; ELECTRODES;MATERIALS;SIZE;LEAD-ACID BATTERIES; USES;DESIGN

1109 PROCESSING TECHNOLOGY FOR SCRAP STORAGE BATTERY LEAD. Chumachenko, V.S.; Raskina, R.D.; Bondarenko, F.F. Tsvetn. Met.; No. 5, 70-4(1975).
LEAD-ACID BATTERIES;WASTE PROCESSING;LEAD

1110 ANODIC DISSOLUTION OF LITHIUM--ALUMINUM ALLOYS IN A LITHIUM CHLORIDE--POTASSIUM CHLORIDE MELT. L'vov, A.L.; Gnilomedov, A.A.; Selemenev, A.P.; Protasov, E.N. (Sarat. Gos. Univ., Saratov, USSR). Elektrokhimiya; 11: No. 9, 1322-4(1975).
LITHIUM ALLOYS;ALUMINIUM BASE ALLOYS; CHEMICAL PREPARATION;ANODES;PRESSING;ELECTRIC POTENTIAL;LITHIUM CHLORIDES;POTASSIUM CHLORIDES; HIGH TEMPERATURE;DIFFUSION;TEMPERATURE DEPENDENCE;ACTIVATION ENERGY;ELECTRIC BATTERIES; LITHIUM-SULFUR BATTERIES;ELECTRODES;FABRICATION; DISSOLUTION

1111 DEVELOPMENT OF SILVER--ZINC AND SILVER--CADMIUM BATTERIES. Arkhangel'skaya, Z.P.; Ivanov, E.G.; Kotousov, S.G.; Neuvorueva, E.M. Sb. Rab. Khim. Istochnikam Toka; 10: 249-68(1975).
SILVER-ZINC BATTERIES;SILVER-CADMIUM BATTERIES;REVIEWS

1112 HERMETIC STANDBY SILVER--ZINC STORAGE BATTERY. Ivanov, E.G.; Levenfish, P.G.; Pal'mskaya, I.Ya. Sb. Rab. Khim. Istochnikam Toka; 10: 322-7(1975).
Electrochemical absorber of H based on NiO(OH) system. SEALS;SILVER-ZINC BATTERIES; FABRICATION;PERFORMANCE;NICKEL OXIDES;NICKEL HYDROXIDES

1113 DEVELOPMENT OF AN ALKALINE NICKEL--IRON STORAGE BATTERY FOR ELECTROMOBILES. Aksel'rod, Sh.S.; Gershman, M.B.; Lamedman, E.M.; Shapot, M.B. Sb. Rab. Khim. Istochnikam Toka; 10: 171-7(1975).
32 Wh/kg for 5 h discharge time, for trucks. IRON-NICKEL BATTERIES;ELECTRIC-POWERED VEHICLES; HYDROXIDES;TRUCKS;COOLING;PERFORMANCE

1114 HIGH-TEMPERATURE NICKEL--NICKEL STORAGE BATTERY. Kloss, A.I.; Borisov, B.A. Sb. Rab. Khim. Istochnikam Toka; 10: 166-70(1975).
80° to 150°, 0.1 to 10 A. MEDIUM TEMPERATURE; NICKEL;METAL-METAL OXIDE BATTERIES;ELECTRIC POTENTIAL;TEMPERATURE DEPENDENCE;LIFETIME; NICKEL HYDROXIDES

1115 RECENT DEVELOPMENTS IN ADVANCED SECONDARY BATTERIES. Barger, H.J. Jr. (Army Mobility Equipment Research and Development Center, Fort Belvoir, VA). pp 24-28 of Energy and the environment. Earley, D.E. (ed.). Dayton, OH; American Institute of Chemical Engineers (1975).
From Proceedings on energy and the environment; College Corner, Ohio, USA (13 Nov 1974).
See CONF-741179--.
The status of some advanced secondary batteries is reviewed. The impact of such systems on energy conservation and the environment is examined. 11 figures. (auth)

1116 BATTERIES. Brockris, J.O. (Flinders Univ. of South Australia, Bedford Park). pp 183-203 of Solar energy. Messel, H.; Butler, S.T. (eds.). Elmsford, NY; Pergamon Press, Inc. (1975).
An introduction to primary and secondary batteries and fuel cells is given. Both lead-acid and newly developed (Li--Cl, Na--S, and Zn--air) batteries are described. The fundamentals of fuel cells are illustrated for the regenerative $H_2/O_2$ fuel cell. The efficiency and power output of fuel cells in general, the relation between fuel cells and electrolysis, and the importance of porous electrodes are treated. Near-term applications of fuel cells are suggested. Attention is directed to the burning of fossil fuels and the $CO_2$ balance, as well as fossil fuel burning and the oxygen balance: these topics are discussed to point out the need for finding alternatives to fossil fuels. The concept of the hydrogen economy is sketched. 6 figures, 1 table. (RWR)

1117 ELECTROCHEMICAL HEAT ENGINES FOR DIRECT ELECTRIC POWER GENERATION AND ENERGY STORAGE. Elliott, G.R.B.; Trela, W.J.; Dials, G.E. New York; American Institute of Aeronautics and Astronautics, Inc. (1975). 7p.
From 11. AIAA/SAE propulsion conference; Anaheim, CA, USA (29 Sep 1975).
Batteries can be operated in heat engine cycles analogous to the cycles of usual mechanical heat engines but without the mechanical motion of pistons, turbines, etc. These electrochemical cycles can be used for direct generation of electric power and for storage of energy. The Los Alamos Scientific Laboratory is in the initial stages of development of such engines which can accept heat in the temperature range of 1700 to 900°K, then drop the temperature to the range 800 to 600°K while doing useful electrochemical work. These systems offer promise as topping cycles for steam turbines, and they could be used for mine-mouth generation of electric power following in situ gasification of coal--here the rejected heat from the generation can be used in endothermic processes underground. Such processes include preliminary drying of the coal bed, frequently a necessary step in in situ gasification, as well as coal pyrolysis to produce a substitute feedstock for petroleum refineries of the future, plus gasification itself.

1118 ZINC--BROMINE STORAGE BATTERY FOR ELECTRIC VEHICLES. Clerici, G.; de Rossi, M.; Marchetto, M. (Magneti Marelli battery Labs., Milan). pp 167-181 of Power sources 5. Collins, D.H. (ed.). New York; Academic Press Inc. (1975).
From 9. international power sources symposium; Brighton, UK (17 Sep 1974).
See CONF-740908--.
Constructional features, performance and life testing of a prototype zinc--bromine storage battery for an electric city vehicle are described. Designed, built, and experimented with in the laboratory with promising results, this battery makes use of thin bipolar titanium electrodes, zinc being deposited on the negative and bromine on the positive side. Titanium passivation is prevented by coating the positive side of the bipolar titanium electrode with conductive ceramic oxides. An aqueous electrolyte is used consisting of a concentrated solution of zinc bromide acidified to pH 1.5--2 with bromic acid, and circulated through each cell.

1119 PERFORMANCE OF IRON--AIR SECONDARY CELLS UNDER PRACTICAL OPERATION CONDITIONS. Cnobloch, H.; Groeppel, D.; Kuehl, D.; Nippe, W.; Siemsen, G. (Forschungslaboratorien der Siemens AG, Erlangen, Ger.). pp 261-282 of Power sources 5. Collins, D.H. (ed.). New York; Academic Press Inc. (1975).
From 9. international power sources symposium; Brighton, UK (17 Sep 1974).
See CONF-740908--.
The cell consists of an iron electrode, working on both sides, which is opposed by two air electrodes. During the charging and discharging of metal--air cells, water evaporates from the electrolyte. The losses can be compensated for by flooding the gas spaces of the air electrodes with water during the charging phase. Potassium hydroxide solution serving as electrolyte absorbs carbon dioxide from the air. The carbon dioxide is removed by a newly developed process, in which the air streams around porous matter soaked with absorbing liquid. Parallel with the reduction of iron, hydrogen is evolved. By using copper instead of nickel as supporting material the hydrogen evolution rate can be markedly decreased.

1120 IRON--AIR BATTERY SYSTEMS FOR TRACTION PURPOSES. Lindstroem, O. (Royal Inst. of Tech., Stockholm). pp 283-301 of Power sources 5. Collins, D.H. (ed.). New York; Academic Press Inc. (1975).
From 9. international power sources symposium; Brighton, UK (17 Sep 1974).
See CONF-740908--.
The iron--air battery is a promising power source with a high energy density for qualified traction applications. Prototype systems have been tested in underground operations. Results and experiences obtained so far in the project are summarized.

1121 RECHARGEABLE NICKEL--ZINC CELL WITH AN AUXILIARY ELECTRODE. Benczur-Uermoessy, G.; von Benda, K.; Haschka, F. (Deutsche Automobilgesellschaft mbH, Esslingen, Ger.). pp 303-314 of Power sources 5. Collins, D.H. (ed.). New York; Academic Press Inc. (1975).
From 9. international power sources symposium; Brighton, UK (17 Sep 1974).
See CONF-740908--.
A nickel--zinc cell with soluble zinc anodes and an auxiliary electrode has been devised which effectively overcomes the problems of

dendrites and shape change. The auxiliary electrode acts as a dendrite barrier during charge and prevents shape change by dissolution of residual zinc after discharge. At the 1 h rate, a 4 A h cell has delivered about 30 W h/kg for over 1200 cycles, and a 8 A h cell has attained 38 W h/kg.

1122 SEALED METAL OXIDE--HYDROGEN SECONDARY CELLS. Dunlop, J.; Stockel, J.; van Ommering, G. (COMSAT Labs., Clarksburg, MD). pp 315-329 of Power sources 5. Collins, D.H. (ed.). New York; Academic Press Inc. (1975).
From 9. international power sources symposium; Brighton, UK (17 Sep 1974).
See CONF-740908--.
Two new types of sealed metal oxide--hydrogen secondary cells, the nickel hydroxide--hydrogen (Ni--$H_2$) and the silver oxide--hydrogen (Ag--$H_2$) cells, are being developed for light-weight, long-life, rechargeable batteries. Laboratory Ni--$H_2$ cells have already demonstrated over 10,000 cycles at 28 percent depth of discharge. The first series of light weight 50 A h cells, now under test, has a measured energy density of 55 W h/kg with a maximum cell operating pressure of 30 atm (3 MN/m²). An alternative approach is chemical storage of the hydrogen in the form of a hydride. Using $LaNi_5$ for storage of hydrogen, cells typically operate at less than 4 atm (405 kN/m²) of pressure. When energy density is the major consideration, the Ag--$H_2$ system appears very promising. While these cells do not have the cyclic life expectancy of the Ni--$H_2$ cells, their energy density is about 50 percent greater (70--90 W h/kg).

1123 SEALED, RECHARGEABLE SILVER--HYDROGEN BATTERY. Klein, M. (Energy Research Corp., Bethel, CT). pp 347-359 of Power sources 5. Collins, D.H. (ed.). New York; Academic Press Inc. (1975).
From 9. international power sources symposium; Brighton, UK (17 Sep 1974).
See CONF-740908--.
The silver--hydrogen couple represents the marriage of the rechargeable hydrogen electrode, of the fuel cell type, and the silver electrode used in silver--zinc batteries. This battery system is capable of delivering energy densities in the 75--100 W h/kg range at approximately 10 W h/cm³ depending on cell size and rate of discharge. The mechanical approach taken for the cell construction is a single cylindrical cell in which the electrode stack is placed. The stack consists of repeating layers of silver electrodes, separator material, bifunctional hydrogen electrodes, and gas diffusion screens. The stack of disc electrodes is assembled within a cylindrical shaped pressure vessel which serves as a hydrogen storage container and a cell housing. During charge hydrogen gas is generated on the surface of the hydrogen electrode and is stored within the void volume of the cell housing. During discharge the hydrogen gas is reacted on the fuel cell electrode. The operating pressure range of typical cells is 6.8--34 atm (0.7--3.5 MN/m²) of hydrogen. Platinum hydrophobic fuel cell electrodes are utilized as the negative electrodes, composite layers of inorganic separator materials are used for the separator and sintered silver electrodes have been used for the positives. Complete 25 A h light-weight cells have been assembled and tested. The advantages of this system include insensitivity to over-charge, continued float and reversal, high energy density and long cycle life.

1124 EXPERIMENTAL ALUMINUM--SULPHUR CELL. Redey, L.; Porubszky, I.; Molnar, I. (Technical Univ., Budapest). pp 559-572 of Power sources 5. Collins, D.H. (ed.). New York; Academic Press Inc. (1975).
From 9. international power sources symposium; Brighton, UK (17 Sep 1974).
See CONF-740908--.
Anodic and cathodic behavior of Al and a S impregnated porous carbon body has been examined in $AlCl_3$--NaCl--KCl melt. On the basis of these experimental results cells 40 mm in diameter by 80 mm in height have been constructed and studied. The experimental Al--S cells are capable of operating between 100°C and 350°C. However, the best results can be achieved in the temperature range of 200--300°C. A cup-shaped Al anode itself covers the cell which can be completely sealed because of the absence of gaseous materials. There is no need for a diaphragm. Experience has proved the rechargeability of this system. The cell construction described is not really adequate to give a high power density, although it indicates the feasibility of the Al--S galvanic system.

1125 MATHEMATICAL MODELING OF LEAD--ACID BATTERIES. Gerasimenko, Yu.Ya.; Kukoz, F.I.; Sinel'nikov, E.M.; Lyubiev, O.N.; Goncharov, V.I. Izv. Vyssh. Uchebn. Zaved., Elektromekh.; No. 3, 250-258(1975). (In Russian).
The mathematical model of a lead accumulator is obtained as a set of equations of the electric and concentration fields. The model is utilized for the calculation of voltage and current of the accumulator during its discharge in different operating conditions.

1126 LIGNOCELLULOSE BATTERIES. POTENTIAL SOURCES OF STORED ELECTRICAL ENERGY. Steelink, C.; Wilkinson, A. (Univ. of Arizona, Tucson). Tappi; 58: No. 11, 146-147(1975).
LIGNIN;CELLULOSE;QUINONES;ELECTRIC BATTERIES; CHEMICAL PREPARATION;HIGH TEMPERATURE;PYROLYSIS; ZINC;ELECTRIC POTENTIAL;PERFORMANCE;ELECTRODES

1127 REPLACEMENT BATTERY. INDUSTRY FORECAST 1975--1979, A REPORT BY THE BCI STATISTICAL COMMITTEE. pp 34-40 of Battery Council International convention: 1975. Chicago; Battery Council International (1975).
From 87. Battery Council International convention; Hollywood, Florida, USA (8 Apr 1975).
See CONF-7504129--.
The market for replacement lead--acid batteries of the automotive type is discussed. A model which attempts to forecast demands for replacement batteries is explained. (RWR) 16 figures.

1128 SODIUM--SULFUR BATTERY. Weiner, S.A. (Ford Motor Co., Detroit). pp 54-62 of Battery Council International convention: 1975. Chicago; Battery Council International (1975).
From 87. Battery Council International convention; Hollywood, Florida, USA (8 Apr 1975).
See CONF-7504129--.
Possible application of the sodium--sulfur battery to load leveling and electric propulsion is explained. Deficiencies of these batteries (and others) are discussed. The electrochemistry of the sodium--sulfur battery is considered; the importance of the ceramic is emphasized. A fairly large amount of research and development work remains to be done. 9

figures, 4 tables. (RWR)

1129 GOULD DRYNAMIC BATTERY. Sabatino, A. (Gould, Inc., St. Paul). pp 100-104 of Battery Council International convention: 1975. Chicago; Battery Council International (1975).
From 87. Battery Council International convention; Hollywood, Florida, USA (8 Apr 1975).
See CONF-7504129--.
In this type of dry charge battery the plates and separators are moist and contain 20 to 40% of the acid which normally would be present in a wet battery. The seal plugs allow hydrogen to escape but prevent entry of air. These batteries have high initial activation cold cranking capacity and excellent capacity retention. Fabrication of this type of battery, compatible with the conventional wet processing, is explained. (RWR) 9 figures.

1130 ILZRO HEALTH STUDIES. Cole, J.F. pp 114-119 of Battery Council International convention: 1975. Chicago; Battery Council International (1975).
From 87. Battery Council International convention; Hollywood, Florida, USA (8 Apr 1975).
See CONF-7504129--.
The research effort of the International Lead Zinc Research Organization, Inc. encompasses the effects of lead emissions to the atmosphere on the general public, as well as studies in the water pollution and occupational health fields. The study discussed deals with the effects of lead exposure on children living in the area of a lead smelter. The ILZRO concluded that comprehensive testing failed to reveal any detrimental effects of lead on the health or well-being of the children. [(RWR) 12 figures.

1131 ENVIRONMENTAL CONTROL PROBLEMS. Bitler, J. (General Battery Corp., Reading, PA). pp 120-123 of Battery Council International co vention: 1975. Chicago; Battery Council International (1975).
From 87. Battery Council International convention; Hollywood, Florida, USA (8 Apr 1975).
See CONF-7504129--.
Regulatory problems as related to battery production are discussed. The first part of the report considers lead discharged into water. Clarification of waste material by treatment with lime also results in problems. Other ways of dealing with sludge are related. Antimony is another waste which must be handled. The second part of the paper deals with pollution of air by lead. (RWR)

1132 ALKALINE BATTERY. Nabiulin, F.Kh.; Buzova, Z.M.; Gertsik, E.M.; Koval, I.I.; Maslov, V.M.; Khamits, L.N. French Patent 2,232,094. 27 Dec 1974. Filed date 4 Jun 1973. 17p.
Patent; allows free access of air to cathode. ELECTRIC BATTERIES;DESIGN;AIR;CATHODES; HYDROXIDES;GASES

1133 LEAD--OXYGEN DC POWER SUPPLY SYSTEM. Britz, W.J.; Boshers, W.A.; Kaufmann, J.J. (to NASA). US Patent Application 537,024. 27 Dec 1974. 19p.
Patent application. LEAD;OXYGEN;METAL-GAS BATTERIES;ELECTRIC-POWERED VEHICLES;POWER SUPPLIES;GRIDS;TEFLON;CATALYSTS;DESIGN

1134 CHEMICAL SOURCE OF ELECTRIC POWER. Nikol'skii, V.A.; Rusin, A.I.; Yudilevich, S.R.; Batin, A.P. USSR Patent 454,618. 25 Dec 1974. Filed date 16 Apr 1973.
Patent; $Cu/H_2SO_4/PbO_2$. METAL-METAL OXIDE BATTERIES;COPPER;LEAD OXIDES;SULFURIC ACID; STORAGE;DESIGN

1135 BONDED COMPONENT ASSEMBLY FOR FLAT CELLS AND METHOD THEREFOR. Kordesch, K.V. (to Union Carbide Corp.). US Patent 3,944,435. 24 Dec 1974. vp.
A component assembly for use in electrochemical cells is described. It comprises a first component, a second component, and at least one plastic nonconductive network having openings disposed substantially coextensively between and adhesively secured to the first component at one of its faces and to the second component at its opposite face. It thereby maintains the first and second components in a secured, spaced-apart relationship. The openings have active or inactive material in contact with the faces of the two components.

1136 ALKALINE BATTERY ELEMENT. Nabiulin, F.Kh.; Buzova, S.M.; Gertsyk, E.M.; Koval, I.I.; Maslov, V.M.; Khamits, L.N. German(FRG) Patent 2,412,843. 19 Dec 1974. Filed date 4 Jun 1973. 25p.
DESIGN;ZINC-AIR BATTERIES;CATHODES

1137 EXPANSION CHAMBER ARRANGEMENT IN SODIUM--SULFUR CELLS. Halliday, D.B; Evans, L.S.; Harbar, J.R. (to United Kingdom Secretary of State for Trade and Industry). German(FRG) Patent 2,424,639. 19 Dec 1974. Filed date 22 May 1973. 16p.
SODIUM-SULFUR BATTERIES;ALUMINIUM OXIDES; DESIGN;CYLINDRICAL CONFIGURATION

1138 RECOMBINATION OF GASES FORMED IN SECONDARY BATTERIES. Dietz, H. (to Bosch, Robert, G.m.b.H.). German(FRG) Patent 2,326,169. 12 Dec 1974. Filed date 23 May 1973. 11p.
ELECTRIC BATTERIES;WATER;LOSSES;HYDROGEN; OXYGEN;CHEMICAL REACTIONS;GASES

1139 HIGH-ENERGY-DENSITY IRON--NICKEL BATTERY. Brown, J.T.; Feduska, W.; Hardman, C.C.; Pollack, W. (to Westinghouse Electric Corp.). US Patent 3,853,624. 10 Dec 1974. Filed date 17 Jul 1970. 7p.
IRON-NICKEL BATTERIES;FABRICATION;IRON OXIDES;NICKEL HYDROXIDES;SULFUR;SELENIUM; TELLURIUM;ELECTROLYTES;HYDROXIDES;BASES

1140 GASTIGHT ALKALINE BATTERY WITH PASTE AND SINTERED ELECTRODE. Dickfeldt, S. (to Varta Batterie AG). US Patent 3,852,110. 3 Dec 1974. Filed date 11 Oct 1973. 6p.
ELECTRIC BATTERIES;DESIGN;SEALS;HYDROXIDES; ELECTRODES;SINTERED MATERIALS

1141 BATTERY RECLAMATION AND DISPOSAL PRACTICES. Environ. Sci. Technol.; 8: No. 13, 1074-5(Dec 1974).
TOXICITY;WASTE DISPOSAL;WATER POLLUTION; SOLID WASTES;MANAGEMENT;ENVIRONMENTAL EFFECTS; LAND POLLUTION;MATERIALS RECOVERY;ELECTRIC BATTERIES;POLLUTION REGULATIONS

1142 RECHARGEABLE ELECTROCHEMICAL CELL HAVING

COMPLEX METAL FLUORIDE ELECTROLYTE. Senderoff, S. (to Union Carbide Corp.). US Patent 28,250. 26 Nov 1974. Filed date 12 Mar 1971. 12p.
Patent; Be/alkali metal fluoroberyllate/ $NiF_2$, AgF, or $AgF_2$. METAL-NONMETAL BATTERIES; BERYLLIUM;ZIRCONIUM;NICKEL FLUORIDES;SILVER FLUORIDES;DESIGN;ALKALI METAL COMPOUNDS; FLUORINE COMPOUNDS;ZIRCONATES;BERYLLIUM COMPOUNDS;OXYGEN COMPOUNDS;ELECTROLYTES

1143 SOME PROBLEMS ON THE APPLICATION AND DEVELOPMENT OF ELECTROCHEMICAL POWER SOURCE. Ch'a, Ch'uan-sheng. (Chem. Dept., Wuhan Univ.). Hua Hseuh Tung Pao; No. 6, 55-61(23 Nov 1974).
Possible solid-electrolyte batteries (e.g. Li--air) of 1000 W-hr/kg. ELECTRIC BATTERIES; METAL-GAS BATTERIES;LITHIUM;AIR;COMPARATIVE EVALUATIONS;POWER;ENERGY;ELECTROLYTES;SOLIDS; FORECASTING

1144 SULFUR--SODIUM BATTERY. Chiku, T.; Yoshida, T.; Koboso, T.; Matsui, N. (to Toyota Central Research and Development Laboratories, Inc.). Japanese Patent 121,925. 21 Nov 1974. Filed date 30 Mar 1973. 5p.
SODIUM-SULFUR BATTERIES;ALUMINIUM OXIDES; TUBES;DESIGN

1145 ELECTROCHEMICAL CELL WITH ANHYDROUS ELECTROLYTE SOLUTION. Fraiolo, A.V.; Mohns, J.P. (to American Cyanamid Co.). British Patent 1,374,334. 20 Nov 1974. Filed date 3 Mar 1972. 4p.
Patent; $SO_2$-containing electrolyte of Al, reduced corrosion. ELECTRIC BATTERIES; ELECTROLYTES;ANHYDRIDES;DESIGN;SULFUR OXIDES; ALUMINIUM COMPOUNDS;CORROSION;PASSIVATION

1146 NICKEL--ZINC STORAGE BATTERY. Takamura, T.; Shirogami, T.; Sato, Y.; Murata, K.; Niki, H. (to Tokyo Shibaura Electric Co. Ltd.). US Patent 3,951,687. 20 Nov 1974. Priority date 21 Nov 1973, Japan. vp.
In a nickel--zinc storage battery a sheetlike separator is interposed between a sheet-like zinc electrode and a sheet-like nickel electrode, and the columnar electrode body is housed in a cylindrical case. The sheet-like zinc electrode is prepared by bonding under pressure to a collector, a mixture sheet consisting of 60 to 85 weight percent of zinc oxide, 5 to 20 weight percent of zinc, 2 to 30 weight percent of bismuth oxide, 5 to 20 weight percent of calcium hydroxide and 2 to 13 weight percent of fluorine-contained resin. The sheet-like nickel electrode is prepared by bonding under pressure to a collector an oxide of nickel together with a conductive material. The sheet-like separator is prepared by coating on an alkali-resisting woven or nonwoven fabric a mixture of polyvinyl alcohol and at least one selected from the group consisting of boron compounds and metal oxides having low solubility to alkali solution.

1147 METHOD OF MANUFACTURING A METAL--AIR BATTERY. Pompon, J.-P. (to Compagnie General d'Electricite, Paris, France). US Patent 3,849,202. 19 Nov 1974. Filed date 20 Dec 1972. 8p.
METAL-GAS BATTERIES;AIR;FABRICATION;ZINC-AIR BATTERIES;ELECTRIC-POWERED VEHICLES;TUBES;FLUID FLOW;SUSPENSIONS;ZINC;HYDROXIDES;GASES

1148 SEALED SODIUM--IODINE BATTERY. Charles, R.J.; Mitoff, S.P. (to General Electric Co., Schenectady, NY). US Patent 3,849,200. 19 Nov 1974. Filed date 18 Jun 1971. 4p.
Patent; solid electrolyte and electrodes 120°C operating temp, β-alumina electrolyte. SEALS;METAL-NONMETAL BATTERIES;SODIUM;IODINE; SOLIDS;MEDIUM TEMPERATURE;DESIGN;ALUMINIUM OXIDES;SODIUM OXIDES

1149 BATTERY FOR IGNITION OF INTERNAL COMBUSTION ENGINES. Vegh, I.; Gyongyossy, D.; Fekete, J. (to Eurocom Kulkereskedelmi Kepviseleti Rt.). GE 2,329,726. 14 Nov 1974. Filed date 14 Jul 1972. 10p.
LEAD-ACID BATTERIES;DESIGN;LOW TEMPERATURE; MEDIUM TEMPERATURE;BATTERY SEPARATORS;INTERNAL COMBUSTION ENGINES

1150 BATTERIES WITH ALKALINE ELECTROLYTE AND SINTERED ELECTRODES. Glaser, H.; Mardersteig, H.G. (to Varta Batterie AG). GE 2,319,616. 14 Nov 1974. Filed date 18 Apr 1973. 10p.
Sintering of electrodes to case parts. ELECTRIC BATTERIES;ELECTRODES;SINTERING; FABRICATION;ELECTROLYTES;HYDROXIDES;BASES

1151 HIGH DISCHARGE BATTERIES. Cailley, J.P. (to Societe des Accumulateurs Fixes et de Traction). French Patent 2,225,850. 08 Nov 1974. Filed date 22 Dec 1972. 5p.
ELECTRIC BATTERIES;DESIGN;ELECTRODES

1152 PREVENTION OF ADHESION OF PILED PASTED LEAD--ACID BATTERY CATHODES. Dyson, J.I. (to Oldham International Ltd.). German(FRG) Patent 2,417,524. 7 Nov 1974. Filed date 19 Apr 1973. 20p.
LEAD-ACID BATTERIES;CATHODES;ADHESION; MAGNESIUM SULFATES

1153 STORAGE BATTERY. Desai, R.R. (to Globe-Union, Inc.). US Patent 3,846,175. 5 Nov 1974. Filed date 18 Jan 1968. 6p.
Patent; sealed, maintenance-free with cylindrical electrodes. LEAD-ACID BATTERIES; SEALS;ELECTRODES;CYLINDRICAL CONFIGURATION; DESIGN;SULFURIC ACID

1154 DEFERRED ACTION BATTERIES. Mauch, R.E.; Sarbacher, R.I. (to Bogue, John C.). US Patent 3,846,177. 5 Nov 1974. Filed date 30 May 1972. 9p.
ELECTRIC BATTERIES;DESIGN;ELECTROLYTES; STORAGE

1155 PROPORTIONED CURRENT BATTERY. Barrett, E.L. US Patent 3,846,174. 5 Nov 1974. Filed date 11 Apr 1973. 8p.
ELECTRIC BATTERIES;LIFETIME;EFFICIENCY; DESIGN;ELECTRIC CURRENTS;ELECTRODES;PLATES

1156 GUIDE TO BATTERIES AND BATTERY DEVELOPMENT. Shayer, B. OEM Des. (GB); 3: No. 9, 64-5, 67, 69(Nov 1974).
ELECTRIC BATTERIES;PLANNING

1157 CURRENT AND FUTURE APPLICATIONS OF LEAD BATTERIES. Lasserre, P. Mater. Tech.; 62: No. 11, 451-454(Nov 1974). (In French).
A review is presented of the current status of development and future prospects of three types of electric lead batteries; i.e., starting batteries for thermal engines, traction batteries for electric vehicles, and stationary batteries used for various purposes,

such as for auxiliary signaling installations, emergency or security purposes, etc.

1158 STARTING LEAD BATTERIES: A CONSTANT PROGRESS TOWARD SERVICE-FREE BATTERIES. Wilmotte, F. Mater. Tech.; 62: No. 11, 455-458(Nov 1974). (In French).
The current status of development in the field of automobile starting lead batteries is described in detail, and the additional improvements and features which will presumably characterize the battery of tomorrow are discussed. 7 refs.

1159 ALKALINE BATTERY. Berger, M.C.; Dietlin, H.J.P. French Patent 2,224,883. 31 Oct 1974. Filed date 27 Mar 1974. 21p.
Patent; $Co_2O_3$-coated Cu anode, $AlF_3$-coated Al cathode, $Ca(ClO_4)_2$ and NaOH electrolyte, coiled ribbon cell, 5 A-hr at 6.75 V. ELECTRIC BATTERIES;COBALT OXIDES;COPPER;ALUMINIUM FLUORIDES;ALUMINIUM;CALCIUM COMPOUNDS; PERCHLORATES;SODIUM HYDROXIDES;DESIGN; CELLOPHANE;GELS

1160 NONAQUEOUS BATTERY. Bennion, D.N.; Dunning, J.S.; Tiedemann, W.H.; Hsueh, L. (to US Dept. of the Navy). US Patent 3,844,837. 29 Oct 1974. Filed date 7 Jul 1972. 5p.
Patent; Li/Li salt ($LiCF_3SO_3$, $LiClO_4$, $LiBF_4$) in dimethyl sulfide or propylene carbonate/ graphite. METAL-NONMETAL BATTERIES;GRAPHITE; FABRICATION;POLYPROPYLENE;SUBSTRATES;LAMELLAE; LITHIUM;CARBONIC ACID DERIVATIVES;PERCHLORATES; LITHIUM COMPOUNDS;SULFITES;CARBON FLUORIDES; FLUOROBORATES

1161 MODULAR BATTERY CONSTRUCTION. Baker, B. (to Energy Research Corp., Bethel, CT). US Patent 3,844,841. 29 Oct 1974. Filed date 29 Dec 1972. 8p.
ELECTRIC BATTERIES;LEAD-ACID BATTERIES; NICKEL-CADMIUM BATTERIES;NICKEL-ZINC BATTERIES; SILVER-ZINC BATTERIES;SILVER-CADMIUM BATTERIES; DESIGN;SHEETS;ELECTRODES

1162 DRY CHARGED BATTERY WITH A FILLING OF ELECTROLYTE CONCENTRATE, WHICH IS ABOVE THE PLATES IN A CLOSED CONTAINER. Sam, A. (to Gould, Inc.). GE 1,596,115. 24 Oct 1974. Filed date 28 May 1966. 6p.
ELECTRIC BATTERIES;ELECTROLYTES;SOLVENTS; F'LYETHYLENES;SULFURIC ACID;POTASSIUM HYDROXIDES;CARBON TETRACHLORIDE;DESIGN

1163 LEAD DIOXIDE CELL. Kobayashi, Y.; Matsuno, S. (to Yuasa Battery Co., Ltd.). Japanese Patent 74 39,327. 24 Oct 1974. Filed date 25 Aug 1967. 3p.
Patent; $PbO_2$/Mg. ELECTRIC BATTERIES;LEAD OXIDES;MAGNESIUM;SEAWATER;ELECTROLYTES; MAGNESIUM HYDROXIDES;SEDIMENTATION;MIXING

1164 INSTANTLY USABLE STORAGE BATTERY. Muramatsu, M.; Kawase, T. (to Matsushita Electric Industrial Co., Ltd.). Japanese Patent 74 39,332. 24 Oct 1974. Filed date 26 Mar 1969. 3p.
Patent; anode with oxidation-preventing resin coating decomposed by electrolyte. LEAD-ACID BATTERIES;ANODES;OXIDATION;DESIGN;COATINGS; RESINS;ANTIOXIDANTS;FABRICATION;PERFORMANCE

1165 SOLID ELECTROLYTE BATTERY. Terasaki, M. (to Japan Storage Battery Co., Ltd.). JA 111,128. 23 Oct 1974. Filed date 24 Feb 1973. 4p.
Uses compressed inert gas to maintain constant anode area, hence steady power output. SODIUM-SULFUR BATTERIES;DESIGN;INERT ATMOSPHERE

1166 SOLID ELECTROLYTE BATTERY. Terasaki, M. (to Japan Storage Battery Co., Ltd.). JA 111,127. 23 Oct 1974. Filed date 24 Feb 1973. 4p.
Steady power output by using compressed inert gas to maintain constant anode area. SODIUM-SULFUR BATTERIES;DESIGN;INERT ATMOSPHERE

1167 SEALED BATTERIES FABRICATED WITH EVAPORATED POLY(PARAXYLENE). Ito, Z. (to Matsushita Electric Industrial Co., Ltd.). Japanese Patent 74,109,841. 18 Oct 1974. Filed date 22 Feb 1973. 4p.
FILMS;XYLENE-PARA;CHLORINATED AROMATIC HYDROCARBONS;SEALS;CONTAINERS;NICKEL-CADMIUM BATTERIES;PERFORMANCE;NICKEL;COATINGS; FABRICATION

1168 LEAK-PROOF LEAD STORAGE BATTERY. Fujimoto, T.; Hayashi, S. (to Yuasa Battery Co., Ltd.). Japanese Patent 74 109,836. 18 Oct 1974. Filed date 22 Feb 1973. 3p.
LEAD-ACID BATTERIES;FABRICATION;LIFETIME; PERFORMANCE;RESINS;CONTAINERS;SILICON OXIDES; GELS

1169 SODIUM--SULFUR BATTERY. Tilley, A.R. (to British Railways Board). German(FRG) Patent 2,401,636. 17 Oct 1974. Filed date 19 Mar 1973. 10p.
Patent; liquid Na and S, solid β-alumina, gas-tight, 350°. SODIUM-SULFUR BATTERIES; ALUMINIUM OXIDES;HIGH TEMPERATURE;CYLINDRICAL CONFIGURATION;SEALS;ALUMINIUM;ALUMINIUM SULFIDES;DESIGN

1170 EV POWER SOURCES: WAITING FOR A SUPERBATTERY. Jacobson, R.A. Mach. Des.; 46: No. 25, 149-154(17 Oct 1974).
ELECTRIC-POWERED VEHICLES;AUTOMOBILES;ZINC-CHLORINE BATTERIES;ELECTRIC BATTERIES;OPERATION; DESIGN

1171 SOLID-STATE ELECTRIC BATTERIES. Gibson, J.G. (to British Railways Board). British Patent 1,370,624. 16 Oct 1974. Filed date 3 Dec 1970. 3p.
Patent; alkaline earth metal/transition metal fluoride with electrolyte formed by chemical reaction in situ. METAL-NONMETAL BATTERIES;ALKALINE EARTH METALS;CALCIUM; FLUORIDES;TRANSITION ELEMENT COMPOUNDS;COPPER FLUORIDES;CHROMIUM FLUORIDES;IRON FLUORIDES; NICKEL FLUORIDES;PERFORMANCE

1172 BATTERY, COMPONENTS, AND METHOD OF MAKING. Eberle, W.J. (to General Battery Corp., Reading, PA). US Patent 3,841,915. 15 Oct 1974. Filed date 31 Aug 1972. 12p.
AUTOMOBILES;LEAD-ACID BATTERIES;DESIGN; FABRICATION;ELECTRIC BATTERIES

1173 SODIUM SULFUR STORAGE BATTERY. Kagawa, H.; Senoo, K. (to Yuasa Battery Co. Ltd., Osaka, Japan). US Patent 3,841,912. 15 Oct 1974. Filed date 2 Apr 1973. 4p.
SODIUM-SULFUR BATTERIES;DESIGN;ALUMINIUM OXIDES;SODIUM OXIDES

1174 NONAQUEOUS BATTERY ELECTROLYTE. Ikeda,

H.; Saito, T.; Kato, H.; Tamura, H.; Matsuda, Y. (to Sanyo Electric Co., Ltd.). Japanese Patent 105,928. 7 Oct 1974. Filed date 15 Feb 1973. 3p.
Patent; Li/$ICl_3$ in $LiClO_4$--propylene carbonate/$IC_3$ in C. METAL-NONMETAL BATTERIES; LITHIUM;GRAPHITE;ELECTROLYTES;IODINE CHLORIDES; LITHIUM COMPOUNDS;PERCHLORATES;CARBONIC ACID DERIVATIVES;ESTERS;DESIGN;PERFORMANCE

1175 SECONDARY BATTERY. Morton, H. (to Oldham International Ltd.). UK 1,368,887. 2 Oct 1974. Filed date 13 Mar 1972. 6p.
Flexible filling spouts. ELECTRIC BATTERIES; OPENINGS;DESIGN

1176 HIGH POWER DENSITY LEAD-ACID BATTERY. Badger, J.P. (to Eltra Corp.). Canadian Patent 955,646. 01 Oct 1974. Filed date 20 Nov 1969. 13p.
LEAD-ACID BATTERIES;DESIGN;PERFORMANCE

1177 WATER ACTIVATED LEAD ACID STORAGE BATTERY CELL HAVING DRY DISCHARGED ELECTRODES. Duddy, J.C. (to ESB Inc.). US Patent 3,839,089. 1 Oct 1974. Filed date 18 May 1973. 5p.
LEAD-ACID BATTERIES;ELECTROLYTES;SULFATES; SULFITES;PHOSPHATES;ALKALI METAL COMPOUNDS; DESIGN

1178 WATER ACTIVATED LEAD ACID STORAGE BATTERY CELL HAVING DRY DISCHARGED ELECTRODES. Duddy, J.C. (to ESB Inc., Philadelphia, PA). US Patent 3,839,089. 1 Oct 1974. Filed date 18 May 1973. 6p.
LEAD-ACID BATTERIES;CHEMICAL ACTIVATION; ALKALI METAL COMPOUNDS;SULFATES;WATER;SODIUM SULFATES;HYDRATES;DESIGN

1179 WATER ACTIVATED LEAD--ACID STORAGE BATTERY CELL HAVING DRY DISCHARGED ELECTRODES. (to ESB, Inc.). US Patent 3,839,089. 1 Oct 1974. Filed date 18 May 1973. vp.
A lead--acid battery is described which has dry, discharged electrodes containing mainly lead sulfate and is activated by the addition of water followed by charging. Sodium acid sulfate in the form of a pressed pellet is included in the cell and is located above the electrodes. When the cell is activated, the sodium acid sulfate helps to produce a uniform electrolyte and reduce corrosion and dendrite formation.

1180 ELECTROCHEMICAL CELL ASSEMBLED IN DISCHARGED STATE. Yao, N.P.; Walsh, W.J. (to Energy Research and Development Administration). US Patent 3,947,291. 30 Sep 1974. vp.
A completely discharged secondary electrochemical cell assembly having a cell housing, a positive and a negative electrode disposed within the housing, and a molten electrolyte including a lithium salt between the positive and negative electrodes comprises, in the positive electrode, a metallic mesh comprising a metal selected from the group consisting of Fe, Co, Ni, Cu and Mo disposed in a containment structure, an intimate mixture consisting essentially of solid, particulate $Li_2S$ and molten electrolyte embedded into the metallic mesh in uniform quantities throughout the mesh, and a positive electrode terminal in electrical contact with the mixture and metallic mesh; and in the negative electrode, a porous solid mass consisting essentially of aluminum metal and a negative electrode terminal in electrical contact with the mass of aluminum, the negative and positive electrode terminals being electrically accessible from outside the cell housing for connection of a source of electrical potential to electrochemically form a metallic sulfide of a metal selected from the group consisting of Fe, Co, Ni, Cu and Mo within the positive electrode and lithium--aluminum alloy within the negative electrode. Also discussed is a method of preparing an electrochemical cell having a positive electrode with iron sulfide as a reactant, a negative electrode with lithium, in the form of lithium--aluminum alloy, as a reactant, and an electrolyte including a lithium salt between the positive and negative electrodes. The improved method is described.

1181 CHEMICAL SOURCE OF ELECTRIC POWER. Rodionov, A.I.; Grudyanov, I.I.; Plakhtii, L.A.; Sachkov, S.I.; Yusinov, A.A. USSR Patent 444,278. 25 Sep 1974. Filed date 19 Apr 1973.
Patent; alkali metal hydride/alkali metal halide in HF/halide. ELECTRIC BATTERIES;HALIDES; ALKALI METAL COMPOUNDS;HYDROFLUORIC ACID; HYDRIDES;ALKALI METALS;METAL-NONMETAL BATTERIES; LITHIUM HYDRIDES;DESIGN

1182 SODIUM SULFUR STORAGE BATTERY. Nakabayashi, T. (to Agency of Industrial Science and Technology, Tokyo, Japan). US Patent 3,837,918. 24 Sep 1974. Filed date 14 Mar 1973. 4p.
Patent; battery comprising double vessel with thermal insulating layer. SODIUM-SULFUR BATTERIES;DESIGN;THERMAL INSULATION;COOLING; HEATING;TEMPERATURE CONTROL;ALUMINIUM OXIDES; SODIUM OXIDES

1183 (AD/A--006093) STATE STANDARDS OF THE USSR, LEAD--ACID AUTOMOTIVE STORAGE BATTERIES GOST 959.0-71. 20 Sep 1974. Translation of Russian State Standard GOST 959.0-71, 1973. (FSTC-HT--23-930-74). 67p. NTIS $4.25.
A review of state standards for lead starting storage batteries used in heavy vehicles is presented. The standards show methods in which the batteries must be tested, stored, transported and packed, as well as their general specifications. The general specifications of various types of storage batteries are given, as is a breakdown of the arbitrary designation of each of them. (GRA)

1184 ELECTRICAL ISOLATION OF BATTERY CELLS HAVING A CIRCULATING ELECTROLYTE SYSTEM. Bennett, D.R. (to Lucas, Joseph, (Industries) Ltd.). British Patent 1,367,673. 18 Sep 1974. Filed date 26 Mar 1971. 3p.
Patent; introduction of air bubbles. ELECTRIC BATTERIES;DIELECTRIC MATERIALS;AIR; BUBBLES;DESIGN;ELECTROLYTES;FLUID FLOW

1185 REGENERATIVE METAL--WATER BATTERY. Will, F.G.; Mitoff, S.P. (to General Electric Co.). US Patent 3,833,422. 3 Sep 1974. Filed date 20 Apr 1972. 5p.
Patent; K or Na. METAL-NONMETAL BATTERIES; POTASSIUM;SODIUM;WATER;DESIGN

1186 BATTERY WITH ELECTROLYTE COMPOSED OF FUSED MINERAL SALTS AND WITH CHLORINE ELECTRODE. Bonnemay, M.; Guy, B.; Sarradin, J. (to Agence Nationale de Valorisation de la Recherche). French Patent 2,216,683. 30 Aug 1974. Filed date 7 Feb 1973. 18p.
Patent; Al/NaCl--$AlCl_3$/Cl--metal, where the

metal is Fe, Ni, Cr, Ti, Mo, W, or V or an alloy or cermet of one of them. METAL-GAS BATTERIES;ALUMINIUM;SODIUM CHLORIDES;ALUMINIUM CHLORIDES;IRON;NICKEL;CHROMIUM;TITANIUM; MOLYBDENUM;TUNGSTEN;VANADIUM;ALLOYS;CERMETS; FABRICATION

1187 METAL--AIR SECONDARY BATTERY. Oliapuram, A. (to Varta Batterie AG). GE 2,309,716. 29 Aug 1974. Filed date 27 Feb 1973. 9p.
METAL-GAS BATTERIES;DESIGN;CONFIGURATION; ELECTROLYTES;ELECTRODES

1188 SODIUM--SULFUR BATTERY. Lazennec, Y.; Lasne, C.; Minjolles, L. (to Compagnie Generale d'Electricite). German(FRG) Patent 2,407,926. 29 Aug 1974. Filed date 28 Feb 1973. 19p.
Patent; large number of anodic and cathodic chambers. SODIUM-SULFUR BATTERIES;LITHIUM ALLOYS;SODIUM;ALUMINIUM OXIDES;DESIGN

1189 HOMOGENEOUS CATHODE MIXTURES FOR SECONDARY ELECTROCHEMICAL POWER-PRODUCING CELLS. Cairns, E.J.; Shimotake, H.; Selman, J.R. (to US AEC). US Patent 3,827,910. 6 Aug 1974. Filed date 30 Nov 1972. 12p.
Alkali metal/chalcogen; patent. METAL-NONMETAL BATTERIES;ALKALI METALS;SULFUR;HALOGEN COMPOUNDS;DESIGN;PERFORMANCE

1190 MAGNETOPOLYPILE TUBULAR BATTERY. Justic, D.S. US Patent 3,827,912. 6 Aug 1974. Filed date 30 Mar 1971. 3p.
ELECTRIC BATTERIES;DESIGN;TUBES;ELECTRIC-POWERED VEHICLES;AUTOMOBILES

1191 BASE FOR LEAKPROOF ELECTROCHEMICAL CELLS AND METHOD OF FORMING THE SAME. Sanchez, D.L. (to Pilas Secas Jupiter S.A.). US Patent 3,951,690. 1 Aug 1974. Priority date 5 Aug 1971, Spain. vp.
A method of leak-proof sealing a dry electrochemical cell is described. The cell is formed by a metallic cup which acts as a negative electrode, in which are positioned an electrolyte, a depolarizer mass, and a positive electrode extending beyond one end of the cup. This whole assembly is introduced into a casing of a thermoplastic material which closes the cell at the end with a terminal of the positive electrode, as well as at the opposite end, formed by the bottom of the cup, onto which is fixed in electrical contact a metallic part which serves as a terminal of negative electrode. The method comprises the following: providing a metallic dish as the terminal of the negative electrode, the dish having a bottom wall perforated with several apertures in the periphery and having an annular side-wall and a shoulder between the side-wall and the periphery, and fitting the dish onto the side-wall of the cup with the shoulder supporting the bottom of the cup and providing a continuous gap between the bottom wall of the dish and the bottom of the cup; introducing the cup with the dish into the thermoplastic casing to a position wherein the end of the casing extends beyond the bottom of the cup; axially compressing the dish and the cup and forcing hot thermoplastic material through the apertures in such a way that the hot material blocks the apertures and is present on both sides of the apertures and the bottom wall of the dish; and cooling the thermoplastic material which is present on both sides of the apertures and joined to the casing until the material solidifies.

1192 CHEMICAL SOURCE OF ELECTRIC POWER. Krotov, I.V. (to Ordzhonikidze, S., Aviation Inst., Moscow). USSR Patent 437,154. 25 Jul 1974. Filed date 11 Aug 1972.
Patent; Ag/organic electrolyte with Ca halide/Ca halide-coated Cd. METAL-NONMETAL BATTERIES;SILVER;CALCIUM HALIDES;ELECTROLYTES; ORGANIC COMPOUNDS;DESIGN

1193 SODIUM--SULFUR CELLS. Sudworth, J.L.; Tilley, A.R. (to British Railways Board). German(FRG) Patent 2,401,726. 25 Jul 1974. Filed date 16 Jan 1973. 12p.
Patent; concentric tubes. SODIUM-SULFUR BATTERIES;DESIGN;TUBES;FABRICATION

1194 ELECTROCHEMICAL CELL WITH CATALYZED ACID PEROXIDE ELECTROLYTE. MacCarthy, R.W. US Patent 3,825,445. 23 Jul 1974. Filed date 19 Mar 1973. 10p.
$Mg/HCl--H_2O_2--MgCl_2--FeCl_3--CuCl_2/C$. METAL-NONMETAL BATTERIES;MAGNESIUM;HYDROCHLORIC ACID; HYDROGEN PEROXIDE;MAGNESIUM CHLORIDES;IRON CHLORIDES;COPPER CHLORIDES;CARBON;LITHIUM; CALCIUM;ZINC;ALUMINIUM;DESIGN;ELECTRIC-POWERED VEHICLES

1195 MULTIPLE SOURCE BATTERY-POWERED APPARATUS. Ruggiero, G.W.; Kelly, R.M.; Mazor, E. (to Bell and Howell Co.). US Patent 3,930,889. 22 Jul 1974. vp.
An electric battery in an electrically conducting case forming one terminal for the battery is described. The case has a side surface between first and second ends and encloses one of the ends, an electrically insulating cover over the side surface and the one end, and an aperture in the cover over the side surface located nearer to one of the ends than to the other for giving via the side surface the only contact access to the one terminal. A second battery terminal is located in the other ends.

1196 SODIUM--SULFUR BATTERY. Robinson, G.; Jones, I.W. (to Electricity Council). German(FRG) Patent 2,400,202. 11 Jul 1974. Filed date 3 Jan 1973. 18p.
Patent; stainless steel wire gauge to ensure Na contact with $\beta--Al_2O_3$ electrolyte. SODIUM-SULFUR BATTERIES;DESIGN;ALUMINIUM OXIDES; ELECTROLYTES;SODIUM

1197 IMPLANTABLE BATTERY. Cairns, E.J.; Chilenskas, A.A.; Shimotake, H. (to US AEC). US Patent 3,823,037. 9 Jul 1974. Filed date 20 Jul 1972. 14p.
Li/Se; patent. LITHIUM;SELENIUM;METAL-NONMETAL BATTERIES;HIGH TEMPERATURE;DESIGN; ARTIFICIAL ORGANS;MECHANICAL HEART

1198 BATTERY SEALING METHOD RECEPTIVE TO INJECTION FILLING. Jagid, B.E. (to Power Conversion, Inc., Mt. Vernon, NY). US Patent 3,823,040. 9 Jul 1974. Filed date 29 Aug 1972. 6p.
ELECTRIC BATTERIES;SEALS;INJECTION; ELECTROLYTES;FABRICATION

1199 SEALING CLOSURE FOR ELECTRIC BATTERIES. Sanchez, D.L. (to Pilas Secas Jupiter, S.A., Tolosa, Guipuzcoa, Spain). US Patent 3,823,039. 9 Jul 1974. Filed date 5 Jul 1972. 4p.
METAL-METAL BATTERIES;SEALS;CONTAINERS;

ELECTRODES;ZINC

1200 LEAD--ACID STORAGE BATTERY CAPABLE OF ACTIVATION BY THE ADDITION OF ELECTROLYTE. Mao, G.W.; Sabation, A. (to Gould Inc.). US Patent 3,948,680. 8 Jul 1974. vp.
A lead-acid storage battery comprises a container having several cell compartments and several battery elements consisting of several positive and negative charged plates in the cell compartments with separators positioned between them. The battery sealed, at least substantially, prevents the ingress of air. The battery elements contain a conditioning amount of a metallic sulfate and residual electrolyte. The battery is otherwise substantially free of electrolyte, being activatable by addition of electrolyte.

1201 ENVELOPE FOR THE TUBULAR ELECTRODES OF STORAGE BATTERIES. Breidenbach, H. (to Varta Batterie Aktiengesellschaft). US Patent 3,950,186. 8 Jul 1974. Priority date 23 Jul 1973, German, Federal Republic of (F.R. Germany).
An envelope for the tubular electrodes of a lead--acid storage battery comprises several spaced-apart fabric tubes. Each tube comprises groups of warp threads tied off by weft threads forming a plurality of spacers protruding beyond the diameter of the tube.

1202 COPPER RECYCLING NEED NOT POLLUTE. Iron Age; 214: No. 2, 60(8 Jul 1974).
A recycling furnace, consisting of a fire-brick primary combustion chamber in a metal house, an afterburner, and a stack with a water scrubber, can recover copper from wire at a cost of $1^1/_2$ cents a pound. The furnaces can also be used to recover aluminum from wire and castings, lead from cable sheathing and old storage batteries, and silver from electronic circuit boards and films.

1203 SOLID STATE BATTERY ENCLOSURE. (to Mallory, P.R. and Co., Inc.). UK 1,358,426. 3 Jul 1974. Filed date 18 Nov 1970. 5p.
Use of evacuated interior. ELECTRIC BATTERIES;CONTAINERS;DESIGN;FABRICATION

1204 RECHARGEABLE ZINC ELECTROCHEMICAL ENERGY CONVERSION DEVICE. Hale, H.J. (to E.I. du Pont de Nemours and Co., Wilmington, DE). US Patent 3,822,149. 2 Jul 1974. Filed date 17 Feb 1972. 12p.
ZINC-AIR BATTERIES;BATTERY CHARGING;ELECTRIC-POWERED VEHICLES;RADIO EQUIPMENT POWER SUPPLIES; ELECTROCHEMISTRY;DESIGN;OPERATION

1205 SECONDARY BATTERY BASED ON THE COPPER(II)--(I) AND (I)--(0) COUPLES IN ACETONITRILE. Kratochvil, B.; Betty, K.R. (Univ. Alberta, Edmonton, Canada). J. Electrochem. Soc.; 121: No. 7, 851-4(Jul 1974).
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1206 MORE POWER FOR THE BATTERY. Ford, E. Electr. Eng. (Melbourne); 51: No. 7, 30-1(Jul 1974).
Technological advances and applications. LEAD-ACID BATTERIES;NICKEL-CADMIUM BATTERIES; PERFORMANCE;ELECTRIC BATTERIES

1207 (AD/A--001218) METHOD OF FORMING IRON--NICKEL STORAGE BATTERIES WITH NONLAMELLAR NEGATIVE ELECTRODE. Novakovskii, A.M.; Grushkina, S.A.; Kozlova, R.L.; Drachev, G.G. 26 Jun 1974. Translation of Russian Patent 329,603. (FSTC-HT--23-141-74). 6p. NTIS $3.25.
IRON-NICKEL BATTERIES;FABRICATION;CHEMICAL REACTIONS;IRON IONS;OXIDATION;CATHODES

1208 METAL--AIR OR METAL--OXIDE SECONDARY BATTERIES. (to Rheinisch-Westfaelisches Elektrizitaetswerk AG). French Patent 2,207,365. 14 Jun 1974. Filed date 18 Nov 1972. 9p.
Patent; metal/air element and metal/metal oxide element with common electrolyte and common metal anode. METAL-GAS BATTERIES;METAL-METAL OXIDE BATTERIES;ELECTRIC-POWERED VEHICLES; DESIGN

1209 SILVER--ZINC ELECTRIC STORAGE CELLS. Mote, H.T.; Hajdu, L.; Ronay, B. (to Medicharge Ltd.). US Patent 3,945,851. 13 Jun 1974. Priority date 14 Jun 1973, United Kingdom of Great Britain and Northern Ireland (UK). vp.
A rechargeable silver--zinc electric storage cell is described which comprises a casing enclosing a silver electrode and a zinc electrode, a separator comprising an imperforate semi-permeable membrane disposed between the electrodes, and an electrolyte. The membrane is sealed to the casing so that the only ion path between the electrodes is through the membrane. The imperforate semi-permeable membrane comprises a laminate of plies of semipermeable oriented foil material bonded together with the electrolyte, with some of the plies arranged cross-wise relative to another ply of the membrane.

1210 BATTERY ELEMENTS. (to Rheinisch-Westfaelisches Elektrizitaetswerk AG). French Patent 2,206,593. 7 Jun 1974. Priority date 9 Nov 1972, German, Federal Republic of (F.R. Germany). 8p.
Li/Li compd. in aprotic org. solvent/Sb or As; patent; 0.85 V, 2.03 A-s/g. ELECTRIC BATTERIES;LITHIUM;LITHIUM COMPOUNDS;ANTIMONY; ARSENIC;ORGANIC COMPOUNDS;SOLVENTS;CHLORATES; DESIGN;FABRICATION

1211 BATTERY AND METHOD OF MANUFACTURING THE SAME. Miyagawa, S. (to Miyagawa Kasei Industry Co., Ltd.). US Patent 3,814,632. 4 Jun 1974. Filed date 20 Apr 1972. 8p.
ELECTRIC BATTERIES;FABRICATION;RESINS; CONTAINERS

1212 FILTER/STORE FOR ELECTRIC ENERGY STORAGE DEVICE. Bjorkman, H.K., Jr. (to Occidental Energy Development Co., Madison Heights, MI). US Patent 3,814,630. 4 Jun 1974. Filed date 18 Nov 1971. 8p.
Aqueous electrolyte storage and circulation system; patent. METAL-NONMETAL BATTERIES;DESIGN; ELECTROLYTES;HALOGENS;HYDRATES;STORAGE

1213 ACCUMULATOR CELL. Steig, H. (to Accumulatorenfabriken Wilhelm Hagen AG). US Patent 3,933,522. 4 Jun 1974. vp.
A storage battery comprising a plurality of cells supported one upon another is described. Each cell includes a cuboid housing of

nonconducting material with a liquid electrolyte and positive and negative plate elements therein. The top and bottom sides of the housings have shapes that are complementary to each other in such a way that the cells stack compactly one upon another. An open communication path exists between the liquid electrolyte in the housings of adjoining cells. Electrically conducting means including positive and negative terminal conductors extend through the housings and are liquid tight. Electrical conductors outside the housings of the cells interconnect plate elements of like polarity of adjoining cells. Terminal connecting means interconnecting plates of the same polarity in each cell may include cylindrical lead members extending through the top sides of the housings and sealed fluid tight by injected lead bushings and means including electrical conductors outside the housings of said cells interconnecting plates of like polarity of adjoining cells. A member on the top of the housing, outside the dividing line between the material of the top side of the housing and the lead bushings, may be provided with internally threaded portions concentric with and radially spaced from the cylindrical lead members and annular means threaded into the internally threaded portions for exerting sealing pressure at dividing line.

1214 ENERGY STORAGE. II. DEVELOPING ADVANCED TECHNOLOGIES. Robinson, A.L. Science; 184: No. 4139, 884-887(24 May 1974).
FUSION HEAT;FLYWHEELS;STORED ENERGY;ENERGY STORAGE;INVESTMENT;TRANSPORT;MAGNETIC FIELDS; SUPERCONDUCTIVITY;SUPERCONDUCTORS; ELECTROMAGNETS;HYDROGEN;SOLAR ENERGY;ELECTRIC BATTERIES;FUSION HEAT

1215 SEALANT FOR GALVANIC BATTERIES AND CELLS. Reinert, D.G. (to ESB Inc., Philadelphia, PA). US Patent 3,811,956. 21 May 1974. Filed date 2 Nov 1972. 6p.
FUEL CELLS;ELECTRIC BATTERIES;SEALS; CONTAINERS;FABRICATION

1216 ENERGY STORAGE. I. USING ELECTRICITY MORE EFFICIENTLY. Robinson, A.L. Science; 184: No. 4138, 785-787(17 May 1974).
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1217 PROCESS FOR FORMING AND STORING HALOGEN HYDRATE IN A BATTERY. Symons, P.C. (to Occidental Energy Development Co., Madison Heights, MI). US Patent 3,809,578. 7 May 1974. Filed date 26 Jun 1970. 12p.
METAL-NONMETAL BATTERIES;HALOGENS;HYDRATES; ELECTROCHEMISTRY

1218 PRELIMINARY INVESTIGATION OF HIGH TEMPERATURE LITHIUM/IRON SULFIDE SECONDARY CELLS. Vissers, D.R.; Tomczuk, Z.; Steunenberg, R.K. (Argonne Nat. Lab., IL). J. Electrochem. Soc.; 121: No. 5, 665-7(May 1974).
Lig. Li in stainless steel/LiCl--KCl/ $FeS_2$($Li_2S$, FeS). LITHIUM-SULFUR BATTERIES;HIGH TEMPERATURE;PERFORMANCE;BATTERY CHARGING; LIFETIME;ELECTRIC CONDUCTIVITY;LITHIUM CHLORIDES;POTASSIUM CHLORIDES;IRON SULFIDES; LITHIUM SULFIDES

1219 ASSEMBLING ELECTRODES IN ELECTROCHEMICAL CELLS. Jaggard, A.M. (to Gould Inc., Mendota Heights, MN). US Patent 3,801,375. 2 Apr 1974. Filed date 25 Feb 1972. 8p.
METAL-GAS BATTERIES;ELECTRODES;FABRICATION; WIRES

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1222 COMPUTER AIDED BATTERY PRODUCTION. Kuerbel, U.; Klose, F. (Varta Batterie, Ellwangen, Germany). Elektrotech. Z., B; 26: No. 5, 100-2(8 Mar 1974). (In German).
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1224 BATTERIES WITH IMPROVED SHELF LIFE. Conner, W.P. (to Hercules Inc.). US Patent 3,930,887. 20 Feb 1974. vp.
A battery having self-discharge characteristics and an anode and a cathode within a container is improved by adding a high-resistance element connected across the anode and cathode. The high resistance element has a value selected to provide a predetermined low current drain on the battery.

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Patent; solid or liquid halogen or chalcogen in host material, solid $RbAg_4I_5$ electrolyte. ELECTRIC BATTERIES;IODINE;BROMINE;SULFUR; SELENIUM;TELLURIUM;RUBIDIUM IODIDES;SILVER IODIDES;DESIGN

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1228 ALKALINE AIR--ZINC STORAGE BATTERY. Kocherginskiy, M.D.; Kalachev, S.L.; Naumenko, V.A.; Pen'kova, L.F. USSR Patent 265,998. 31 Jan 1974. Filed date 31 Jan 1969.
ZINC-AIR BATTERIES;DESIGN;ELECTRODES; CONTAINERS

1229 RECHARGEABLE GALVANIC CELL. Ohsawa, K.; Hirasa, K.; Kinoshita, H. (to Furukawa Electric Co., Ltd.). US Patent 3,930,882. 25 Jan 1974. Priority date 31 Jan 1973, Japan. vp.
A rechargeable galvanic cell is described which consists of zinc anode, a cathode, and an electrolyte. The electrolyte comprises an aqueous alkaline solution containing alkali metal zincate and a polycation selected from the group consisting of ionen-type polycations and pendant-type polycations in an amount sufficient to suppress the formation of zinc dendrites on the zinc anode during cell charge. The ionen-type polycation has quaternary nitrogen included in the main chain of the molecule, and the pendant-type polycation has quaternary nitrogen included in the side chain of the molecule.

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METAL-GAS BATTERIES;DESIGN;HYDROGEN;GASES; CONTAINERS;NICKEL-HYDROGEN BATTERIES

1235 RECHARGEABLE LITHIUM--CHLORINE CELL WITH MIXED IONIC MOLTEN SALT ELECTROLYTE. Bradley, T.G.; Sharma, R.A. (General Motors Corp., Warren, MI). pp 60-64 of Proceedings of the 26th power sources symposium. Red Bank, NJ; PSC Publications Committee (1974).
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Ca/LiCl--KCl/$CaCrO_4$/Fe. METAL-METAL BATTERIES;PERFORMANCE;CALCIUM;LITHIUM CHLORIDES; POTASSIUM CHLORIDES;CALCIUM COMPOUNDS;CHROMATES; IRON;LEAKS;SPIN;ELECTRIC CURRENTS

1260 BATTERY SYSTEM OF THE AEROS SATELLITE. Winzer, G. (Dornier System GmbH, Friedrichshafen, Ger.). Raumfahrtforschung; 18: 238-244(1974). (In German).
From Symposium on the scientific-technical results of the Aeros program; Meersburg, Ger. (18 Oct 1973).
SATELLITES;SILVER-ZINC BATTERIES;NICKEL-CADMIUM BATTERIES;FABRICATION;PERFORMANCE

1261 RECOMMENDED PRACTICE FOR INSTALLATION DESIGN AND INSTALLATION OF LARGE STATIONARY GENERATING STATION AND SUBSTATION LEAD STORAGE BATTERIES. IEEE Trans. Power Appar. Syst.; PAS-93: No. 4, 1105-1109(1974).
ELECTRIC POWER;ENERGY STORAGE;THERMAL POWER PLANTS;OFF-PEAK ENERGY STORAGE;LEAD-ACID BATTERIES;DESIGN

1262 MATERIALS CORROSION IN MOLTEN-SALT LITHIUM--SULFUR CELLS. Battles, J.E.; Mrazek, F.C.; Tuohig, W.D.; Myles, K.M. (Argonne National Lab., IL). pp 20-31 of Corrosion problems in energy conversion and generation. Tedman, C.S. Jr. (ed.). Princeton, NJ; Electrochemical Society, Inc. (1974).
From Proceedings of the symposium on corrosion problems in energy conversion and generation; New York, New York, USA (15 Oct 1974).
See CONF-7410138--.
Lithium/sulfur secondary batteries of high specific energy and high specific power are being developed at Argonne National Laboratory for electric-powered vehicles and for load-leveling energy storage applications. Because of the corrosiveness of the cell environment, extensive corrosion testing of potential construction materials is being conducted to enable selection of low-cost materials for cell components. Corrosion tests of numerous materials indicated that the stainless steels and Armco Electromagnet Iron are compatible with the LiCl--KCl electrolyte at 400°C and, hence, suitable for cell housings and assorted hardware. Iron current collectors in the positive electrode showed acceptable compatibility with FeS as the active material, but not with $FeS_2$. Molybdenum, on the other hand, appeared to be completely resistant to attack in the positive-electrode environment for both FeS and $FeS_2$ active materials. Corrosion tests at 400°C of various ceramics indicated that only $Y_2O_3$ is immune to attack by liquid lithium; other materials showed marginal compatibility (e.g., BN, BeO, $CaZrO_3$, MgO, and $MgAl_2O_4$). In-cell tests demonstrated the successful application of BN fabric separators in cells with solid Li--Al negative electrodes. 2 figures, 5 tables (auth)

1263 LONG-LIFE LEAD--FLUOROBORIC ACID BATTERY. McDonald, G.D.; Weissman, E.Y.; Dettwiler, E.R. (Globe-Union, Inc., Milwaukee, WI). Power Sources Symp., Proc.; 26: 120-3(1974).
90 mAh. LEAD-ACID BATTERIES;FLUOROBORATES; HYDROGEN COMPOUNDS;INORGANIC ACIDS;LEAD OXIDES; MEDIUM TEMPERATURE;LOW TEMPERATURE;PERFORMANCE

1264 PHYSICS OPPORTUNITIES IN ELECTROCHEMICAL ENERGY CONVERSION. Cairns, E.J. (GM Res. Lab., Detroit, MI). pp 160-70 of Proceedings of Amer. Phys. Soc. top conference on energy, Chicago, IL, 4-7 Feb 1974. New York; AIP (1974).
From American Phys. Soc. top conference on energy; Chicago, IL (4-7 Feb 1974).
FUEL CELLS;ELECTRIC BATTERIES;REVIEWS;COST;

PERFORMANCE

1265 DEVELOPMENT OF A POWER MODULE USING THIRD ELECTRODE BATTERY CHARGE CONTROL. Corbett, R.E.; Glass, M.C.; Matsui, R.G. (Lockheed Missiles and Space Co., Sunnyvale, CA). pp 137-143 of 9th intersociety energy conversion engineering conference. New York; American Society of Mechanical Engineers (1974).
From 9. intersociety energy conversion engineering conference; San Francisco, CA, USA (26 Aug 1974).
A description of the design and development of a spacecraft power subsystem packaged as a self-contained module is given. Among the unique aspects of this design are the use of a control electrode of a nickel--cadmium cell in the primary charge control function, a highly compact module packaging design, and some unique development and acceptance test features. The power module, weighing 44 lb, is designed to provide power in the 150- to 250-watt range. The module incorporates two 6-ampere-hour batteries whose charging is controlled by sintered-nickel-type control (third) electrodes. (IAA)

1266 168TH NATIONAL MEETING OF THE AMERICAN CHEMICAL SOCIETY, FUEL CHEMISTRY DIVISION, ATLANTIC CITY, NEW JERSEY, SEPTEMBER 8--13, 1974. VOLUME 19, NO. 5. Field, J.H.; Eddinger, R.T. Ann Arbor, MI; Xerox University Microfilms (1974). 168p. (CONF-740955--P2). $7.00.
From 168. national meeting of American Chemical Society; Atlantic City, New Jersey, USA (8 Sep 1974).
Ten papers given at the American Chemical Society Division of Fuel Chemistry meeting held at Atlantic City, N.J., Sept. 8-13, 1974 have been abstracted individually for ERA. They involve the processing of phenolic aqueous wastes from coal gasification plants and petroleum refineries plus some general papers. (LTN)

1267 BATTERY AND CELL REDUNDANCY CONSIDERATIONS FOR LONG DURATION SPACE MISSIONS. Fono, P. (Hughes Aircraft Co., El Segundo, CA). pp 128-136 of Ninth intersociety energy conversion engineering conference proceedings. New York; American Society of Mechanical Engineers (1974).
From 9. intersociety energy conversion engineering conference; San Francisco, CA, USA (26 Aug 1974).
The redundancy requirements in spacecraft nickel--cadmium battery systems are analyzed. Failure modes of both the batteries and control circuits are considered. Designs with multiple batteries are compared with single batteries which incorporate cell failure protection and series redundant cells to meet reliability goals. Battery control and load-sharing circuit efficiencies are evaluated for battery sizing. Sample designs are made for both 50- and 100-Ah batteries. Battery system weights are determined as a function of bus voltage with either boost or buck discharge regulators. Both low-earth-orbit and synchronous-orbit missions are considered. The functional and weight analyses indicate that multiple batteries seem to be an acceptable compromise between the minimum weight and minimum cost systems. For voltages above 100 volts, a single battery should be seriously considered.

1268 WASTE LEAD OXIDE TREATMENT OF LEAD ACID BATTERY MANUFACTURING WASTEWATER. Crandall, C.J.; Rodenberg, J.R. (Marquette Univ., Milwaukee). Purdue Univ., Eng. Bull., Ext. Ser.; No. 145, 194-206(1974).
Composite wastewater discharges from lead--acid battery manufacturing operations are typically low in pH and contain high amounts of dissolved and suspended lead compounds, as well as sulfuric acid. The exact wastewater characteristics will vary, depending on the type of operations employed, the magnitude of these operations, the degree of in-plant recycling and reuse, and the quantity of process water used. Diagrams and tables show data.

1269 DRY-CHARGED STORAGE BATTERIES. (to S.I.C. Societe Industrielle du Caoutchouc S.A.). GE 1,962,445. 29 Nov 1973. Filed date 12 Dec 1969. 4p.
LEAD-ACID BATTERIES;DESIGN;ELECTRIC BATTERIES

1270 ELECTRIC STORAGE UNIT CONSISTING OF A FUEL CELL AND STORAGE BATTERY WITH A COMMON NEGATIVE ELECTRODE CONNECTED IN PARALLEL. Plust, H.G. (to Deutsche Automobilegesellschaft m.b.H.). German(FRG) Patent 1,934,974. 8 Nov 1973. Filed date 10 Jul 1969. 5p.
The system consists of a fuel cell and a storage battery having a common reversible negative electrode connected in parallel. The double system comprises two individual systems with a NiO(OH) common positive electrode 1 mm thick, and $H_2$ as TiH/sub x/ storage negative electrodes. The separator is 0.5 mm thick asbestos.

1271 PHYSICAL LIMITS TO MODERN STORAGE BATTERIES AND THE CHANCES OF THE DEVELOPMENT OF NEW SYSTEMS. Berndt, D.; Niklas, H. (Varta Batterie AG, Kelkheim, German). Elektrotech. Z., A; 94: No. 11, 694-9(Nov 1973). (In German).
ELECTRIC-POWERED VEHICLES;LEAD-ACID BATTERIES;ELECTRIC BATTERIES;USES;HIGH TEMPERATURE

1272 LIMITATIONS OF PRESENT STORAGE BATTERIES AND THE CHANCES OF DEVELOPING NEW SYSTEMS. Niklas, H.; Berndt, D. (Varta Batterie, Kelkheim, Germany). Elektrotech. Z., A; 94: No. 11, 694-9(Nov 1973). (In German).
ELECTRIC BATTERIES;ELECTRIC-POWERED VEHICLES; LEAD-ACID BATTERIES;HIGH TEMPERATURE; ELECTROCHEMISTRY

1273 LIMITATIONS OF PRESENT STORAGE BATTERIES AND THE CHANCES OF DEVELOPING NEW SYSTEMS. Niklas, H.; Berndt, D. (Varta Batterie, Kelkheim, Ger.). Elektrotech. Z., A; 94: No. 11, 694-699(Nov 1973). (In German).
The different aspects for the special development of batteries for electric vehicles are discussed. The energy density given by the electrochemical reaction is diminished as a result of several requirements which must be fulfilled in order to produce a working battery; this situation is exemplified for the lead--acid battery. The possibility of future improvements is discussed. The considerations which are given for the lead-acid battery can be applied to all the other electrochemical systems. For high-temperature systems additional difficulties are to be expected, because thermal isolation of the system is necessary.

1274 ELECTRICAL CONNECTION BETWEEN GROUPS OF LEAD PLATES FOR ELECTRICAL ACCUMULATOR ELEMENTS AND METHOD FOR FORMING THE SAME. Gaide, R. (to Societe Fulmen). US Patent 3,944,436. 9 Oct 1973. Priority date 30 Dec 1970, France. vp.

A method of constructing a multi-cell storage battery comprises the following steps: molding a container of plastic in one piece with outer vertical container walls, an open bottom, longitudinally spaced transversely extending vertical cell partitions, and transversely spaced parallel channels extending longitudinally across the top of the container from and facing upwardly and outwardly of the container, the parallel channels being partially formed by upright spaced walls, the upper faces of the outer vertical container walls, the spaced upright walls defining the channels and the transversely extending partitions being coplanar, the channels having sections spanning adjacent cells and extending through the cell partition separating the adjacent cells; forming longitudinally spaced openings within the base of the channels for receiving plate lugs of the same polarity; inserting a plurality of battery plates through the open bottom of the container when the container is in an inverted position with the edges of the plates contacting the undersides of the channel base and with the lugs inserted within respective openings within the base of the channels; sealably coupling an imperforate bottom member to the open bottom of the container to locate fixedly the plates therein; electrically and mechanically coupling the lugs within channel sections together by at least melting the lugs within the channel sections to form strap connectors therein; and thermal welding a lid onto the container top at the coplanar upper faces of the upright walls defining the channels, the container walls, and the longitudinally spaced partitions to seal the strap connectors within the channel sections.

1275 SODIUM--SULFUR BATTERY. Imai, A.; Magaribuchi, K.; Ozawa, N. (to Tokyo Shibaura Electric Co., Ltd.). Japanese Patent 60,720. 28 Sep 1973. Filed date 24 May 1975. 5p.
SODIUM-SULFUR BATTERIES;DESIGN;SAFETY

1276 INVESTIGATION OF LEAD STORAGE BATTERIES SCRAP PROCESSING BY MELTING WITH ANTIMONY TRISULFIDE. Cengel, J. (Banska Stiavnica, Horna Huta, Czech.). Erzmetall; 26: No. 8, 385-8(Aug 1973). (In German).
Recovery of antimonial lead. LEAD-ACID BATTERIES;WASTE PROCESSING;ANTIMONY SULFIDES; MELTING;LEAD BASE ALLOYS;RECOVERY;MEDIUM VACUUM; VERY HIGH TEMPERATURE;ANTIMONY ALLOYS

1277 INORGANIC ELECTROLYTE SOLVENTS FOR ALKALI METAL BATTERIES. Blomgren, G.E.; Kronenberg, M.L. (to Union Carbide Corp.). German(FRG) Patent 2,262,256. 26 Jul 1973. Filed date 27 Dec 1971. 24p.
Patent; Li, Na, or K/C. LITHIUM;SODIUM; POTASSIUM;GRAPHITE;METAL-NONMETAL BATTERIES; PERFORMANCE;SOLVENTS;ELECTROLYTES;INORGANIC COMPOUNDS

1278 SUPPLY OF ELECTROCHEMICAL ENERGY FOR THE BUNDESWEHR. STANDARDIZATION MEASURES AND TEST EQUIPMENT AT NATO AND NATIONAL LEVELS. Pracher, A. (BWB, Koblenz, Germany). Wehrtechnik.; No. 7, 251-5(Jul 1973).
ELECTRIC BATTERIES;STANDARDS;GERMAN FEDERAL REPUBLIC

1279 ELECTRIC STORAGE BATTERY PROVIDING HIGH ENERGY DENSITY. Cadman, M.A.; Volnov, M.; Tannesberger, H. (to Etat Frascals). US Patent 3,935,025. 29 Jun 1973. Priority date 6 Jul 1972, France. vp.

An electrical storage battery is described which comprises an anode compartment containing at least one reducer metal, a cathode compartment containing an electrically conductive solution comprising at least one salt of the reducer metal in a non-aqueous solvent, at least one electron acceptor in solution in the electrically conductive solution, and a fluid-tight wall for separating the compartments. The wall consists of a solid material which permits the migration, at ambient temperature, of the reducer metal of the anode in the form of ions. The electron acceptor is soluble in the electrically conductive solution contained in the cathode compartment in the reduced state as well as the initial state thereof.

1280 CYLINDRICAL CADMIUM--NICKEL SECONDARY BATTERY. Menard, C.J.; Burkholder, E.L.; Kohl, K.C. (to Gould Inc.). German(FRG) Patent 2,256,077. 20 Jun 1973. Filed date 13 Dec 1971. 27p.
NICKEL-CADMIUM BATTERIES;DESIGN;CYLINDRICAL CONFIGURATION

1281 CELLS FOR LEAD--ACID STARTER BATTERIES. Kubach, G.; Flechsig, E. (to Bosch, Robert, GmbH). GE 2,157,598. 30 May 1973. Filed date 20 Nov 1971. 7p.
LEAD-ACID BATTERIES;DESIGN;PERFORMANCE

1282 BATTERY WITH CHROMIC ACID--SULFURIC ACID ELECTROLYTE FEEDING AT FIRST USE. Huhta-Koivisto, E.E. (to Puolustusministerio). GE 2,252,401. 30 May 1973. Filed date 25 Oct 1971. 15p.
Zn/C; patent. METAL-NONMETAL BATTERIES;ZINC; CARBON;SULFURIC ACID;CHROMIC ACID;AIRCRAFT; DESIGN

1283 BATTERY MATRIX. (to Yuasa Battery Co., Ltd.). French Patent 2,151,668. 25 May 1973. Filed date 8 Sep 1971. 15p.
Patent; mixture of resin and silica gel to hold electrodes and prevent leakage. SUPPORTS; SINTERED MATERIALS;MATRIX MATERIALS;RESINS; SILICA GEL;POLYETHYLENES;LEAD-ACID BATTERIES; FABRICATION;CARBON;POLYPROPYLENE;POLYSTYRENE; POLYAMIDES;PVC

1284 STORAGE BATTERY. Symons, P.C.; Amato, C.J.; Bjorkman, H.K. (to OMF California, Inc.). GE 2,256,366. 24 May 1973. Filed date 18 Nov 1971. 46p.
METAL-NONMETAL BATTERIES;HALOGENS;DESIGN

1285 ELECTRIC BATTERIES FORMED OF STACKED CELLS. Cich, E.R.; Ivey, R.C. British Patent 1,317,068. 16 May 1973. Filed date 24 Aug 1971. 4p.
ELECTRIC BATTERIES;DESIGN;FABRICATION

1286 LEAD--ACID STORAGE BATTERY. Bianchi, G.; Galli, R.; Tentorio, A.; Mapelli, P. (to Montecatini Edison SpA). GE 2,252,712. 10 May 1973. Filed date 28 Oct 1971. 23p.
LEAD-ACID BATTERIES;DESIGN;ALUMINIUM BASE ALLOYS;SILICON ALLOYS

1287 STORAGE BATTERY CELLS. Dickfeldt, S.; Steffens, K. (to Varta A.-G.). GE 2,153,533. 3 May 1973. Filed date 27 Oct 1971. 11p.
ELECTRIC BATTERIES;FABRICATION

1288 HERMETICALLY SEALED NICKEL--HYDROGEN STORAGE BATTERIES. Tsenter, B.I.; Kloss, A.I.; Sergeev, V.M. UK 1,314,481. 26 Apr 1973. Filed date 11 Mar 1971. 7p.
Ni oxide/H; patent. NICKEL-HYDROGEN BATTERIES;SEALS;NICKEL OXIDES;DESIGN

1289 RECHARGEABLE BATTERY. Fresnel, J.M.; Warszawski, B. (to Societe Generale de Constructions Electriques et Mecaniques (Alsthom)). French Patent 2,146,144. 6 Apr 1973. Filed date 20 Jul 1971. 14p.
ZINC-AIR BATTERIES;DESIGN;FABRICATION; FILTERS

1290 RECHARGEABLE BATTERY. Warszawski, B. (to Societe Generale de Constructions Electriques et Mecaniques (Alsthom)). French Patent 2,146,143. 6 Apr 1973. Filed date 20 Jul 1971. 8p.
ZINC-AIR BATTERIES;ELECTRODES;FOILS;DESIGN

1291 THERMAL BATTERY. Carlsten, R.W.; Nissen, D.A. (to Atomic Energy Commission). US Patent Application 222,029. 6 Mar 1973. Filed date 31 Jan 1972. 5p.
The patent describes an improved thermal battery whose novel design eliminates various disadvantages of previous such devices. Its major features include a halide cathode, a solid metal halide electrolyte which has a substantially greater electrical conductance after a phase transition at some temperature, and a means for heating its electrochemical cells to activation temperature.

1292 SULFUR--SODIUM STORAGE BATTERIES. Fally, J.; Richez, J. (to Compagnie Generale d'Electricite). French Patent 2,140,318. 23 Feb 1973. Filed date 10 Jun 1971. 7p.
SODIUM-SULFUR BATTERIES;DESIGN;FABRICATION

1293 BATTERY STACK. Unkle, T.F. Jr.; Loos, J.F. (to Gulf Oil Corp.). US Patent 3,717,505. 20 Feb 1973. Filed date 25 Jun 1970. 7p.
Patent; electrode configuration with internal passageways. ELECTRIC BATTERIES;FUEL CELLS;SEALS;CONTAINERS;ELECTRODES;CONFIGURATION; OPENINGS;DESIGN

1294 MODERN, INDEPENDENT-FROM-THE-MAINS CURRENT SOURCES. Heinze, J. Funk-Fachhaendler; 25: No. 2, 30-31(5 Feb 1973). (In German).
Batteries, fuel cells, thermocouples, and solar batteries. ELECTRIC BATTERIES;FUEL CELLS; THERMOELECTRIC GENERATORS;SOLAR CELL ARRAYS; THERMOCOUPLES;ECONOMICS;MATERIALS;DIRECT ENERGY CONVERTERS

1295 HEXAMETHONIUM--SILVER IODIDE REVERSIBLE CELL. De Rossi, M.; Berardelli, M.L.; Fonseca, G. (Univ. di Roma, Italy). J. Electrochem. Soc.; 120: No. 2, 149-51(Feb 1973).
ELECTRIC BATTERIES;SILVER IODIDES;SOLIDS; ELECTROLYTES;QUATERNARY COMPOUNDS

1296 SOLID-STATE RESERVE BATTERY. Kennedy, J.H.; Chen, F.; Miles, R.C. (Univ. of Calif., Santa Barbara). J. Electrochem. Soc.; 120: No. 2, 171-5(Feb 1973).
$Ag/Ag_3SBr/AuBr/sub\ 2.4+-0.1/$, 10 Wh/lb.
METAL-NONMETAL BATTERIES;SILVER;GOLD BROMIDES; ELECTRIC POTENTIAL;MEDIUM PRESSURE;DESIGN; SILVER SULFIDES;SILVER BROMIDES

1297 HALOGEN HYDRATES. Symons, P.C. (to Energy Development Associates). US Patent 3,935,024. 3 Jan 1973. Filed date 26 Jun 1970. vp.
A method is described for producing electric current from an electrical energy storage device having an electrode compartment containing a positive electrode, a negative electrode comprised of a metallic surface which will combine electrochemically with a halogen, and an ion-permeable diaphragm mounted between the positive electrode and the negative electrode so as to provide a positive electrode compartment and a negative compartment. The method comprises the following steps: circulating an aqueous metal halide electrolyte solution sequentially past the negative electrode in the electrode compartment, externally of the electrode compartment, and back past the negative electrode; circulating an aqueous metal halide electrolyte solution sequentially past the positive electrode in the electrode compartment, externally of the positive electrode compartment, and back past the positive electrode; decomposing a halogen hydrate, thereby producing its thermal decomposition products, namely, halogen and water; passing the decomposition products into the electrolyte from the positive electrode compartment while it is circulating external to the electrode compartment, thereby dissolving at least a portion of halogen from the halogen hydrate; and completing the circuit between the positive and negative electrodes.

1298 DEVELOPING FOR MANUFACTURE OF THE BELL SYSTEM LEAD--ACID BATTERY. Berberick, F.A.; Durr, H.E.; Haller, A.A.; Biron, E.J. West. Electr. Eng.; 17: No. 1, 18-28(Jan 1973).
LEAD-ACID BATTERIES;FABRICATION;GRIDS;PLATES; BONDING

1299 HIGH-RATE DISCHARGE STORAGE BATTERY. Sada, S. (NTT). Jpn. Telecommun. Rev.; 15: No. 1, 62-8(Jan 1973).
ELECTRIC BATTERIES;DESIGN

1300 POWER SOURCES 4: RESEARCH AND DEVELOPMENT IN NON-MECHANICAL ELECTRICAL POWER SOURCES; PROCEEDINGS OF THE EIGHTH INTERNATIONAL SYMPOSIUM, BRIGHTON, SUSSEX, ENGLAND, SEPTEMBER 24-26, 1972. Collins, D.H. (ed.). Newcastle-upon-Tyne, England; Oriel Press, Ltd. (1973). 606p. $24.60.
From 8. International Symposium; Brighton, Sussex, England (24-26 Sep 1972).
LEADING ABSTRACT;METAL-NONMETAL BATTERIES; METAL-METAL BATTERIES;MEETINGS;PROCEEDINGS

1301 SEALED, RECHARGEABLE NICKEL--ZINC CELLS. Charkey, A. (Energy Research Corp., Bethel, CT). pp 93-101 of Power sources 4: Research and development in non-mechanical electrical power sources; Proceedings of the Eighth International Symposium, Brighton, Sussex, England, September 24-26, 1972. Collins, D.H. (ed.). Newcastle-upon-Tyne, England; Oriel Press, Ltd. (1973).
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Progress report on development. NICKEL-ZINC BATTERIES;PERFORMANCE;ELECTRODES;BATTERY SEPARATORS

1302 BIPOLAR NIO(OH)--$K_3BO_3$--ZN ACCUMULATOR. Schneider, F.A. (Eindhoven, Technische Hogeschool, Eindhoven, Netherlands); Dominiczak, Z. pp 115-40 of Power sources 4: Research and development in non-mechanical electrical power sources; Proceedings of the Eighth International Symposium, Brighton, Sussex, England, September 24-26, 1972. Collins, D.H. (ed.). Newcastle-upon-Tyne, England; Oriel Press, Ltd. (1973).
From 8. International Symposium; Brighton, Sussex, England (24-26 Sep 1972).
NICKEL-ZINC BATTERIES;POTASSIUM COMPOUNDS; BORATES;PERFORMANCE TESTING

1303 VERSATILE SILVER OXIDE--ZINC BATTERY FOR SYNCHRONOUS ORBIT AND PLANETARY MISSIONS. Schwartz, H.J.; Soltis, D.G. (NASA-Lewis Research Center, Cleveland, OH). pp 185-99 of Power sources 4: Research and development in non-mechanical electrical power sources; Proceedings of the Eighth International Symposium, Brighton, Sussex, England, September 24-26, 1972. Collins, D.H. (ed.). Newcastle-upon-Tyne, England; Oriel Press, Ltd. (1973).
From 8. International Symposium; Brighton, Sussex, England (24-26 Sep 1972).
SILVER-ZINC BATTERIES;SILVER OXIDES; SATELLITES;SPACE VEHICLES;TESTING

1304 NEW TECHNIQUE FOR MANUFACTURING ELECTRODES BY HOT PRESSING. Jonville, P.; Fresnel, J.M.; Beccu, K.D. (Battelle, Geneva, Switzerland); Bezaudun, J. (Centre National d'Etudes Spatiales, Toulouse, France). pp 223-41 of Power sources 4: Research and development in non-mechanical electrical power sources; Proceedings of the Eighth International Symposium, Brighton, Sussex, England, September 24-26, 1972. Collins, D.H. (ed.). Newcastle-upon-Tyne, England; Oriel Press, Ltd. (1973).
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ELECTRODES;FABRICATION;NICKEL-CADMIUM BATTERIES;HOT PRESSING

1305 NEW LITHIUM NONAQUEOUS SECONDARY BATTERY. Broadhead, J. (Bell Telephone Labs., Inc., Murray Hill, NJ). pp 469-80 of Power sources 4: Research and development in non-mechanical electrical power sources; Proceedings of the Eighth International Symposium, Brighton, Sussex, England, September 24-26, 1972. Collins, D.H. (ed.). Newcastle-upon-Tyne, England; Oriel Press, Ltd. (1973).
From 8. International Symposium; Brighton, Sussex, England (24-26 Sep 1972).
Li/LiI/dichalogenide. METAL-NONMETAL BATTERIES;LITHIUM;PERFORMANCE;IODINE;SULFUR; IODINE COMPOUNDS;NIOBIUM COMPOUNDS;SELENIDES; LITHIUM IODIDES

1306 DEVELOPMENT OF LITHIUM--SULFUR CELLS FOR APPLICATION TO ELECTRIC AUTOMOBILES. Gay, E.C.; Steunenberg, R.K.; Battles, J.E.; Cairns, E.J. (Argonne National Lab., IL). pp 96-103 of 8th intersociety energy conversion engineering conference. Smith, A.H. (ed.). New York; American Inst. of Aeronautics and Astronautics (1973).
From 8. intersociety energy conversion engineering conference; Philadelphia, PA (13 Aug 1973).
ELECTRIC BATTERIES;DESIGN;PERFORMANCE; AUTOMOBILES

1307 DEVELOPMENT OF LITHIUM/SULFUR CELLS FOR APPLICATION TO ELECTRIC AUTOMOBILES. Gay, E.C.; Steunenberg, R.K.; Battles, J.E.; Cairns, E.J. (Argonne National Lab., IL). pp 96-103 of 8th intersociety energy conversion engineering conference proceedings. New York; American Inst. of Aeronautics and Astronautics (1973).
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>200 W-hr/kg. LITHIUM-SULFUR BATTERIES; AUTOMOBILES;ELECTRIC-POWERED VEHICLES;LITHIUM; SULFUR;ARSENIC;CARBON BLACK;LITHIUM FLUORIDES; LITHIUM CHLORIDES;POTASSIUM CHLORIDES; PERFORMANCE;LIFETIME;HIGH TEMPERATURE;BATTERY SEPARATORS

1308 HIGH-ENERGY-DENSITY SILVER--HYDROGEN CELLS FOR SPACE AND TERRESTRIAL APPLICATIONS. Haas, R.J.; Briggs, D.C. (Philco-Ford Corp., Palo Alto, CA). pp 116-20 of 8th Intersociety Energy Conversion Engineering Conference Proceedings, Pt. I, Philadelphia, PA, 13-16 Aug 1973. New York; AIAA (1973).
METAL-GAS BATTERIES;SILVER;HYDROGEN;DESIGN; FABRICATION;COOLING;POLARIZATION;PERFORMANCE TESTING;SPACE VEHICLES

1309 HERMETICALLY SEALED NICKEL--CADMIUM BATTERIES FOR THE SATELLITES, SHINSEI AND DENPA. Ushirokawa, A.; Takahashi, K. (Tokyo Univ., Japan); Ishikawa, T.; Yamamoto, S.; Fujita, K. (Furukawa Battery Co., Ltd., Yokohama, Japan). pp 729-36 of International Symposium on Space Technology and Science, 10th, Tokyo, Japan, 3-8 Sep 1973, Proceedings. Tokyo; AGNE Publishing Inc. (1973).
NICKEL-CADMIUM BATTERIES;SATELLITES;SEALS; DESIGN;LOW TEMPERATURE;MEDIUM TEMPERATURE; PERFORMANCE

1310 NEW EXPLOSIONPROOF ELECTRICAL EQUIPMENT AND CONDITIONS FOR ITS USE. Geskin, S.S.; Shevchenko, I.F.; Khorunzhii, M.V.; Ternovskii, N.A. pp 153-62 of Probl. Goreniya Tusheniya, Mater. Vses. Nauchno-Tekh. Konf., 2nd, 1972. Volume 1. Ryabov, I.V. (ed.). Moscow; Vses. Nauchno-Issled. Inst. Protivopozharnoi Oborony (1973).
Explosion proof gas filter to reduce $H_2$ concentration. ELECTRIC BATTERIES;EXPLOSIONS; SAFETY;FILTERS

1311 METALLURGICAL TREATMENT OF USED LEAD BATTERIES. Melin, A. (Stolberg Ingenieurberatung, Allemagne, Germany). Metallurgie (Mons, Belg.); 13: No. 3, 106-10(1973). (In French).
LEAD-ACID BATTERIES;WASTE PROCESSING;LEAD BASE ALLOYS;ANTIMONY ALLOYS;METALLURGY

1312 OCEAN 73. Fugitt, R.B.; Watanabe, S.; Homma, T.; Mine, H.; Hasegawa, T.; Ohno, K.; Kawai, H.; Gilbert, D.E.; Berju, K.K.; Daniels, E.L.; Strohlein, E.M.; Rolle, A.L.; Uhrich, R.W.B. Jr.; Dietrich, A.J. New York; IEEE (1973). 623p.
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1313 CONTROL BATTERIES (LEAD--ACID): PAST, PRESENT, AND FUTURE PREDICTIONS. Lindrose, C.W. Jr. (Gould, Inc., Cleveland, OH). pp 89-93 of Conference record of 20th annual IEEE Petroleum and Chemical Ind. Conference, Houston, TX, 10-12 Sep 1973. New York; IEEE (1973).
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1882 to 1973. LEAD-ACID BATTERIES;REVIEWS; FORECASTING;MAINTENANCE;OPERATION

1314 RELIABLE DC POWER SYSTEMS FOR STANDBY APPLICATIONS. Stutzbach, R.J. (NIFE Inc., Copiague, NY). pp (Paper 666, 3p.) of Advances in instruments. Volume 28. Proceedings of 28th annual ISA conference, Houston, TX, 15-18 Oct 1973. Part 2. Pittsburgh, PA; ISA (1973).
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1315 FUTURE LOOK AT SMALL MANNED SUBMERSIBLE ENERGY STORAGE SYSTEMS. Dennison, E.S.; Bercheilli, A.S. pp 196-215 of Marine electrochemistry papers. Berkowitz, J.B. (ed.). Princeton, NJ; Electrochemical Society (1973).
From Marine electrochemistry symposium; Miami Beach, FL, USA (8 Oct 1972).
The battery described uses 100 percent O as the cathode and Zn--KOH pellets as the anode. In a 2-h performance test the cells yielded 2 Ah/in.$^2$ and 1.7 Wh/in.$^2$. The batteries, which are refuelable, must be fully enclosed underwater, and are activated by the injection of steam. (RWR)

1316 ZINC--AIR SYSTEM. Cerny, J. (N.P. Bateria, Slany, Czech.). Kniznice Odb. Ved. Spisu Vys. Uceni Tech. Brne, B; 32: 279-288(1973). (In Czech).
Prevention of Zn corrosion, determination of best membranes. ZINC-AIR BATTERIES;ZINC; CORROSION PROTECTION;MERCURY ALLOYS;ZINC ALLOYS; ELECTRIC POTENTIAL;BATTERY SEPARATORS;TEFLON; SODIUM CARBONATES;POROSITY;ANODES

1317 PLANT CELLS. Weston, A.J. Certif. Eng.; 45: No. 12, 267-671(Dec 1972).
LEAD-ACID BATTERIES;FABRICATION;OPERATION; PERFORMANCE;USES;REVIEWS

1318 EQUILIBRIUM PHASES IN THE LITHIUM--SULFUR SYSTEM. Sharma, R.A. (GM, Warren, MI). J. Electrochem. Soc.; 119: No. 11, 1439-43(Nov 1972).
LITHIUM SULFIDES;LITHIUM;SULFUR;PHASE DIAGRAMS;LITHIUM-SULFUR BATTERIES; ELECTROCHEMISTRY;EQUILIBRIUM;MATERIALS;MELTING POINTS

1319 RECENT TRENDS IN THE STORAGE BATTERY INDUSTRY OF JAPAN. Tagawa, H. (Furukawa Battery Co., Yokohama, Japan). J. Appl. Electrochem.; 2: No. 4, 251-63(Nov 1972).
ELECTRIC BATTERIES;JAPAN;REVIEWS

1320 LEAD--ACID BATTERY: A NEW SHAPE FOR AN OLD WORKHORSE. Feder, D.O.; Biagetti, R.V. Bell Lab. Rec.; 50: No. 7, 206-211(Aug 1972).
A novel design and an unusual manufacturing process contribute to a lead--acid battery with superior corrosion resistance and a dramatic improvement in reliability. The cylindrical battery can operate continuously for thirty years in temperatures up to 100° F.

1321 ANHYDROUS HYDROGEN FLUORIDE ELECTROLYTE BATTERY. (to Atomic Energy Commission). US Patent Application 266,092(70). 26 Jun 1972. 12p.
It is an object of the invention to provide a primary cell or battery using ammonium fluoride--anhydrous hydrogen fluoride electrolyte having improved current and power production capabilities at low temperatures. It is operable at temperatures substantially above the boiling point of hydrogen fluoride. (GRA)

1322 ELECTROCHEMICAL POWER-PRODUCING CELL. Cairns, E.J.; Chilenskas, A.A.; Steunenberg, R.K.; Shimotake, H. (to Atomic Energy Commission). US Patent 3,666,560. 30 May 1972. Filed date 21 Sep 1970. 6p.
An electrochemical power-producing cell including a molten lithium metal anode, a molten selenium metal cathode, a paste electrolyte separating the anode from the cathode, an anode current collector, and a single layer of niobium expanded metal formed in corrugated shape as cathode current collector is described. In addition, means are provided for sealing the anode and the cathode from loss of lithium and selenium, respectively, and an insulator is provided between the anode housing and the paste electrolyte disk.

1323 REACTIONS OF SOME OXYGENATED COMPOUNDS OF LEAD WITH ANTIMONY TRISULFIDE. Cengel, J. (Zavod Slovenskeho Narodneho Povstania, Banska Stiavnica, Czech.). Hutn. Listy; 27: No. 4, 279-282(Apr 1972). (In Czech).
On the basis of thermodynamic investigations it is shown that the reactions of lead sulfate, lead dioxide, and lead monoxide with antimony trisulfide have a negative isobaric potential at certain temperatures. The end products of this reaction are hard lead and sulfur dioxide gas. The reaction can be utilized in the reclamation of lead battery scrap.

1324 SECONDARY, RECHARGEABLE METAL/AIR CELL. Palmer, N.I. (to Leesona Corp.). US Patent 3,650,837. 21 Mar 1972. Filed date 6 Apr 1970. 1p.
This cell consists of a porous, regenerable anode and a composite cathode of a material such as teflon. The cathode is layered with catalyst and an electrically conducting bi-porous unit with a fine pore face and a coarse pore face. In operation, the bi-porous unit is flooded and acts as a current collector. During charge, oxygen is evolved at the fine pore face and the ceramic or plastic hydrophilic bubble barrier forces the oxygen into the coarse pore layer; the electrolyte is thus displaced, and the catalyst is protected from damage by the electrolyte. This cell can undergo 100 m cycles, and has an energy density of 50 to 60 Wh/lb. (RWR)

1325 ALUMINUM BROMIDE FUSED-SALT BATTERY. Buzzelli, E.S. (to Standard Oil Co. (Ohio)). US Patent 3,650,834. 21 Mar 1972. Filed date 28 Jan 1970. 5p.
A battery which operates at lower temperatures (50 to 250°) than other molten salt batteries is described. It has an aluminum

anode, a carbon cathode, and an electrolyte of aluminum and alkali metal halides. (RWR)

1326 MULTICELL STORAGE BATTERY. Sundberg, E.G. (to Aktiebolag Tudor). US Patent 3,650,833. 21 Mar 1972. Priority date 21 May 1968, Sweden. 7p.
The locations of electrodes, terminals, and connectors were altered for improved current paths. An alternating arrangement causes diagonal currents in the plates. (RWR)

1327 AFFIXING CURRENT COLLECTORS TO ELECTROLYTIC SECONDARY AND PRIMARY CELLS. Bougaran, M. (to Societe des Accumulateurs Fixes et de Traction). US Patent 3,650,842. 21 Mar 1972. Priority date 1 Apr 1966, France. 5p.
A method of fabricating cells is discussed. The positive and negative plates have edges which project past the separators. Current collectors are welded to parts of these projecting edges. (RWR)

1328 LOW-MAINTENANCE LEAD--ACID BATTERIES HAVING ELECTROLYTE RESERVOIR IN VAPOR CONTACT WITH THE CELLS. Biddick, R.E. (to Gould Inc.). US Patent 3,647,543. 7 Mar 1972. Filed date 14 Nov 1969. 4p.
These batteries have a porous, nonconducting membrane which separates the reservoir from the cells but allows replacement by vapor diffusion of water lost by electrolysis and evaporation. Oxygen can also be transferred from positive to negative plates. (RWR)

1329 WATER-ACTIVATED DRY-CHARGED STORAGE BATTERY HAVING A BUOYANT INTERNAL TEAR STRIP PLASTIC BAG CONTAINING AN ELECTROLYTE-PRODUCING SUBSTANCE. Daniel, F.P. (to ESB Inc.). US Patent 3,647,555. 7 Mar 1972. Filed date 3 Oct 1969. 3p.
When water is added to this battery, a tear strip becomes accessible. Pulling the strip opens a bag to release an electrolyte-producing substance that mixes with the water. (RWR)

1330 SECONDARY BATTERY WITH INDATE ION IN THE ELECTROLYTE. Kawakami, A. (to Hitachi Maxell, Ltd.). US Patent 3,642,539. 15 Feb 1972. Filed date 16 May 1969. 3p.
Copper sheets were washed, amalgamated, and electroplated with zinc to form anodes. Carbonyl nickel powder was sintered onto nickel screens to form cathodes. $InO_2^-$ was added to the KOH electrolyte in an attempt to prevent the formation of spongy zinc during recharging of a battery constructed from these electrodes. After fifteen cycles, the test battery had lost almost none of its capacity. A secondary air battery showed similar results. (RWR)

1331 METAL BROMIDE BATTERY. Zito, R. Jr. (to Zito Co., Inc.). US Patent 3,640,771. 8 Feb 1972. Filed date 20 Oct 1969. 5p.
The cathode of this battery includes a layer capable of adsorbing at least $^1/_2$ its weight of bromine when the battery is charged. The electrolyte consists of a divalent electroplatable bromide dissolved in an aqueous medium. (RWR)

1332 RECHARGEABLE METAL HALIDE BATTERY. Zito, R. Jr. (to Zito Co., Inc.). US Patent 3,640,770. 8 Feb 1972. Filed date 20 Oct 1969. 7p.
This battery contains an electroplatable metal halide. The salt is electrolyzed during charging and reformed during discharge. At least one electrode is made of a conducting, corrodible element. (RWR)

1333 ELECTROCHEMICAL CELL WITH A ZINC ANODE AND ALKALINE ELECTROLYTE. Schneider, G.; Balters, H.; Riedl, W. (to Varta GmbH). German(FRG) Patent 2,035,720. 27 Jan 1972. Filed date 18 Jul 1970. 6p.
ELECTROCHEMICAL CELLS;ZINC;ANODES;HYDROXIDES; CONTAINERS;SILVER-ZINC BATTERIES;NICKEL-ZINC BATTERIES;DESIGN

1334 ELECTROCHEMICAL BATTERIES HAVING NONCONDUCTIVE, REPLACEABLE CELL PARTITIONS. Quisling, S. US Patent 3,635,766. 18 Jan 1972. Filed date 25 Jun 1969. 4p.
The partitions of this battery are set in yielding, nonconducting sealing material. The battery is designed so that one piece can serve as the electrode for two adjacent cells. Cell partitions are connected so that they can be replaced as a unit. (RWR)

1335 WHITHER ELECTROCHEMICAL GENERATORS. II. ACCUMULATORS AND FUEL CELLS. Della Mussia, J.P. Inter Electron.; 26: No. 36, 31-35(17 Jan 1972). (In French).
LIFETIME;ENERGY;LEAD-ACID BATTERIES;NICKEL-CADMIUM BATTERIES;IRON-NICKEL BATTERIES;NICKEL-ZINC BATTERIES;SILVER-CADMIUM BATTERIES;SILVER-ZINC BATTERIES;ZINC-AIR BATTERIES;SODIUM-SULFUR BATTERIES;ELECTRIC BATTERIES;LITHIUM;REVIEWS; TABLES;FUEL CELLS;PLANNING;FORECASTING

1336 REGENERATIVE FUEL CELL SYSTEM. Bloomfield, D.P.; Hassett, N.A.; Stedman, J.K. (to United Aircraft Corp.). German(FRG) Patent 2,132,640. 13 Jan 1972. Filed date 2 Jul 1970. 14p.
Patent; hydrogen fuel cell--secondary battery combination; $H_2O$ produced in fuel cell used by battery. REGENERATIVE FUEL CELLS; HYDROGEN FUEL CELLS;OXYGEN;SULFURIC ACID;LEAD-ACID BATTERIES;DESIGN;WATER;WATER REMOVAL

1337 ELECTRIC BATTERIES. Larsen, D.M.; Terlecke, M.J. (to ESB Inc.). British Patent 1,259,052. 5 Jan 1972. Filed date 13 Apr 1970. 8p.
A rechargeable cell similar in construction to the familiar Leclanche cell is described. Multiple cycling is made possible through the use of an organic depolarizer. The cell consists of a zinc can lined with separator material, a carbon rod in the center, depolarizer, seals, and vents. In one version of the device, the sealant, vent washer, and insulation around the carbon rod are combined in a one-piece polyethylene closure. (RWR)

1338 SIDE-ENTERING STORAGE BATTERY TERMINAL CONSTRUCTION. Coffey, J.P.; Veit, W.E. (to ESB Inc.). US Patent 3,632,450. 4 Jan 1972. Filed date 22 Jun 1970. 4p.
This battery is made in such a way that a part of the terminal post is locked in a pocket formed in the battery container. A terminal insert penetrates the container wall and is welded to the end of the post. (RWR)

1339 MAKING AND OPERATING A GAS-DEPOLARIZED CELL. Yardney, M.N.; Kohen, N. US Patent 3,632,449. 4 Jan 1972. Filed date 30 Jun 1969. 5p.
The cathode of this metal/gas battery

subdivides the interior of the cell housing into a gas passage and an enveloping electrolyte compartment. The anode plates in the electrolyte compartment may be interconnected to form a unit which is detachable from the cathode when the electrode assembly is removed from the housing. Thermal convection is used to circulate the depolarizing gas inside the housing. (RWR)

1340 SPACE SHUTTLE ORBITER POWER SYSTEM REQUIREMENTS AND DESIGN. Lombard, J.W. (Sperry Rand Corp., Space Support Div., Huntsville, AL). pp 12-67 to 12-70 of Energy 70; proceedings of the Fifth Intersociety Energy Conversion Engineering Conference, Las Vegas, Nevada, September 21-25, 1970. Volume 2. Hinsdales, IL; American Nuclear Society (1972).
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1341 25-KW SOLAR ARRAY/BATTERY DESIGN FOR AN EARTH-ORBITING SPACE STATION. Stevenson, R.D. (McDonnell Douglas Astronautics Co., Huntington Beach, CA). pp 12-18 to 12-25 of Energy 70; proceedings of the Fifth Intersociety Energy Conversion Engineering Conference, Las Vegas, Nevada, September 21-25, 1970. Volume 2. Hinsdale, IL; American Nuclear Society (1972).
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1342 NICKEL--CADMIUM CELLS FOR LOW EARTH ORBIT APPLICATIONS. Levy, E. Jr. (Hughes Aircraft Co., El Segundo, CA); Kerr, R.L. pp 47-52 of Proceedings of the 25th power sources symposium. Red Bank, NJ; PSC Publications Committee (1972).
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1343 SODIUM--SULFUR BATTERIES. Levine, C. (Dow Chemical Co., Walnut Creek, CA). pp 75-77 of Proceedings of the 25th power sources symposium. Red Bank, NJ; PSC Publications Committee (1972).
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1345 GELLED ACID WATER-ACTIVATED LEAD--ACID BATTERIES. Amlie, R.F.; Weissman, E.Y.; Qureshi, N.M. (Globe-Union, Inc., Milwaukee). pp 67-71 of Proceedings of the 25th power sources symposium. Red Bank, NJ; PSC Publications Committee (1972).
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1346 SEALED NICKEL--ZINC CELLS. Charkey, A. (Energy Research Corp., Bethel, CT). pp 64-67 of Proceedings of the 25th power sources symposium. Red Bank, NJ; PSC Publications Committee (1972).
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1347 SEALED AIRCRAFT BATTERY WITH INTEGRAL POWER CONDITIONER. McWhorter, T.A.; Bishop, W.S. (Air Force Aero Propulsion Lab., Wright-Patterson AFB, OH). pp 89-91 of Proceedings of the 25th power sources symposium. Red Bank, NJ; PSC Publications Committee (1972).
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ZINC-AIR BATTERIES;DESIGN;PERFORMANCE; ELECTRIC-POWERED VEHICLES

1365 RECHARGEABLE AL/$CL_2$ BATTERY WITH MOLTEN $ALCL_4$- ELECTROLYTE. Holleck, G.L.; Giner, J.; Burrows, B. (Tyco Labs., Waltham, MA). pp 305-310 of From electrocatalysis to fuel cells. Sandstede, G. (ed.). Seattle; University of Washington Press (1972).
A molten salt system based on Al and $Cl_2$ carbon electrodes, with an $AlCl_3$--alkali chloride eutectic as electrolyte, offers promise as a rechargeable, high-energy-density battery which can operate at a relatively low temperature. Electrode kinetics studies showed that the electrode reactions at the Al anode were rapid and that the observed passivation phenomena were due to the formation at the electrode surface of a solid salt layer resulting from concentration changes on anodic or cathodic current flow. It was established that carbon electrodes were intrinsically active for chlorine reduction in $AlCl_3$--alkali chloride melts. By means of a rotating vitreous carbon disk electrode, the kinetics parameters were determined. 7 figures, 1 table.

1366 CHARACTERISTICS OF METAL--AIR SYSTEMS. Beccu, K.D. (Institut Battelle, Geneva). pp 311-332 of From electrocatalysis to fuel cells. Sandstede, G. (ed.). Seattle; University of Washington Press (1972).
In recent years metal--air systems have received large research and development expenditures because of their attractive energy densities, their promising performance and their ability to be electrically, chemically, or mechanically recharged. The objective of the research and development is a high-energy-density power source for military or civilian applications and in particular for use in an electric vehicle. Although a large variety of systems has been investigated and numerous technologies have been set up, this objective has not yet been attained. The major problems still to be overcome are not only of a fundamental nature, such as the passivation phenomena of certain metals during discharge, but also of a more technological aspect, such as the optimal recharge process of the anode, the heat evolution during high power drain, and the corrosion reaction at high temperature. In this paper emphasis is put on the still-remaining problems of the most advanced system--zinc/air operating in alkaline solution. The shortcomings and the advantages of the other systems--Cd--, Fe--, Ga--, Al--, Mg--, Li--, Ca--, Pb--, and Na--air--are briefly outlined. The cathode of the cell, the air--oxygen electrode, is considered only when incompatibility with the electrolyte or the anodic discharge product have been reported. 17 figures, 1 table.

1367 ELECTROCHEMISTRY PROGRAM AT USAECOM. Gilman, S. (Army Electronics Command, Fort Monmouth, NJ). pp 169-180 of From electrocatalysis to fuel cells. Sandstede, G. (ed.). Seattle; University of Washington Press (1972).
USAECOM is active in research, development and advanced development of a wide spectrum of battery devices. A few examples of the activities are discussed. High energy batteries utilizing organic solvents, organic cathode depolarizers and fused salts are in the research and development stage. Air-depolarized batteries with hydrazine, methanol, zinc anodes are reaching the stage of final development. Magnesium dry cells have been successful for some time but are undergoing further refinement.

1368 NEW GENERATORS AND ELECTROCHEMICAL CONVERSION OF ENERGY. Bronoel, G. Rev. Quest. Sci.; 143: No. 3, 349-368(1972). (In French).
FUEL CELLS;ELECTRIC BATTERIES;ZINC-AIR BATTERIES;ELECTROCHEMICAL CELLS;REVIEWS; THERMODYNAMICS;ELECTROCHEMISTRY;OVERVOLTAGE; POLARIZATION;CHARGE TRANSPORT

1369 MOLTEN SALT BATTERIES AND FUEL CELLS. Swinkels, D.A.J. (Broken Hill Prop. Co., Ltd., Shortland, Australia). Adv. Molten Salt Chem.; 1: 165-223(1972).
156 references. HIGH-TEMPERATURE FUEL CELLS; MOLTEN SALTS;ELECTROLYTES;REVIEWS;HIGH TEMPERATURE;ELECTRIC BATTERIES;AQUEOUS SOLUTIONS

1370 ZINC--OXYGEN BATTERIES. Sandera, J. (Vysoke Uceni Technicke, Brno). Kniznice Odb. Ved. Spisu Vys. Uceni Tech. Brne; B-27: vp(1972). (In Czech).
Poly(tetrafluoroethylene) (I)/Ag or

poly(phenylene oxide)/Ag electrodes. ZINC-AIR BATTERIES;OXYGEN;TEFLON;IODINE;SILVER;CURRENT DENSITY;ELECTRODES;POLYPHENOLS

1371 SYMPOSIUM ON NON-FOSSIL CHEMICAL FUELS. VOL. 16, NO. 4. Chicago; American Chemical Society (1972). 176p. (CONF-720402--P1). University Microfilms International $4.00.
From 163. national meeting on American Chemical Society; Boston, Massachusetts, USA (9 Apr 1972).
Individual papers were indexed for inclusion in the Energy Data Base. (LK)

1372 REFUELABLE BATTERIES. Blurton, K.F.; Oswin, H.G. (Energetics Science Inc., New York). Am. Chem. Soc., Div. Fuel Chem., Prepr.; 16: No. 4, 48-69(1972).
From 163. national meeting on American Chemical Society; Boston, Massachusetts, USA (9 Apr 1972).
See CONF-720402--P1.
In the non-fossil fuel society, it is proposed that hydrogen will be produced at nuclear power stations and transported via pipeline to the consumer, where it will be used for heating, cooking, etc., and for the local production of electricity via fuel cells. Electrochemical power sources will replace hydrocarbon-fueled equipment for many applications, such as vehicles. A new battery system will be required for medium-power applications in the hydrogen-fueled society, and refuelable (mechanically rechargeable) batteries are one possibility. This paper reviews the present technology of refuelable metal/air batteries and discusses the future research required on these systems. Advantages and disadvantages of the metal/air system in the hydrogen economy are pointed out. Anodes treated are Zn, Al, Mg, Fe, and Cd. 6 figures, 5 tables. (RWR)

1373 RECHARGEABLE ALUMINUM/CHLORINE BATTERY WITH MOLTEN $ALCL_4^-$ ELECTROLYTE. Holleck, G.L.; Giner, J.; Burrows, B. (Tyco Lab., Inc., Waltham, MA). pp 305-310 of Electrocatalysis fuel cells. Sandstede, G. (ed.). Seattle; Univ. of Washington Press (1972).
A rechargeable, high-energy-density battery capable of operation at low temperature is based on Al- and Cl-C electrodes with an $AlCl_3$--alkali metal chloride eutectic as electrolyte. Electrode reactions and passivation phenomena are discussed. (RWR)

1374 RECOMBINING HYDROGEN AND OXYGEN IN A SEALED BATTERY AND CONTROLLING RECOMBINATION AT CATALYTIC SURFACES. Kreidel, E.L.; Shooter, D. (to Koehler Manufacturing Co.). US Patent 3,630,778. 28 Dec 1971. Filed date 15 Oct 1969. 13p.
This two-stage device comprises a perforated body which has exposed catalytic surfaces with low capacity for recombining gases and an inner nucleus of enclosed catalytic material. Gases initially react in the nucleus, where cumulative heating occurs. This heat raises the temperature of the exposed catalytic surfaces to temperatures at which sustained recombination takes place. The process is designed so that the temperature can not exceed certain values. Water from recombined gases is returned to the electrolyte. (RWR)

1375 ELECTRIC STORAGE BATTERY. Purcell, T.H. Jr.; Jordan, A.W. (to National Aeronautics and Space Administration). US Patent 3,625,766. 7 Dec 1971. Filed date 26 Nov 1969. 10p.
This battery contains flexible, narrow plates and is designed to resist impact forces. (RWR)

1376 MAINTENANCE-FREE STORAGE BATTERY HAVING AN ELECTROLYTE DISSOLVED IN WATER AND A HYDROGEN-OXYGEN FUEL CELL ABOVE THE ELECTRODE PLATES. Reber, H.; Ebeling, A. (to Bosch, Robert, G.m.b.H.). German(FRG) Patent 1,471,766. 25 Nov 1971. Filed date 18 Sep 1964. 4p.
HYDROGEN FUEL CELLS;OXYGEN;DESIGN;HYBRID SYSTEMS;HYDROGEN;ELECTRIC BATTERIES

1377 CYLINDRICAL, RECHARGEABLE CELL CONTAINING AN ORGANIC DEPOLARIZER. Larsen, D.M.; Terlecke, M.J. (to ESB Inc.). US Patent 3,622,392. 23 Nov 1971. Filed date 1 Nov 1968. 5p.
The depolarizer is azodicarboxamide, $RR^1NOCN:NCONR^2R^3$, where R, $R^1$, $R^2$, and $R^3$ are each H or C/sub 1-4/ alkyl. Also included in the cell are means of insulating the portion of the carbon rod in the cell air space, a laminated separator about almost all the inner wall of the negative electrode can, a laminated insulator along the interior bottom of the negative electrode can, and a vent washer. A special one-piece plastic closure was developed. (RWR)

1378 RECHARGEABLE CELL HAVING MOVING TAPE AND ROTATING ELECTRODES. Clifford, J.E. (to AMP Inc.). US Patent 3,620,843. 16 Nov 1971. Filed date 5 Sep 1969. 11p.
This cell has two cylindrical, rotatable, air-permeable cathodes and a long tape anode, coated on both sides with zinc. The potassium hydroxide electrolyte is contained in a porous separator attached to each zinc surface. The tape moves in contact with the cathodes as it passes from storage reel to takeup reel, at speeds dependent on load. Tape direction is reversed during charging. (RWR)

1379 PERMANENT GAS-TIGHT, SEALED NICKEL--CADMIUM STORAGE BATTERY. Ackermann, R.; Brackmann, E.; Christian, K.H.; Schwabe, L.; Georgi, H. (to VEB Grubenlampenwerke). German(FRG) Patent 1,671,975. 4 Nov 1971. Filed date 31 Mar 1967. 6p.
A battery with suppressed hydrogen evolution and charging with constant voltage is described. (RWR)

1380 SECONDARY POWER-PRODUCING CELL. Fischer, A.K. (to Atomic Energy Commission). US Patent 3,605,828. 26 Oct 1971. Filed date 9 Mar 1970. 3p.
This cell consists of an anode and a cathode containing the same two elements in different proportions and an electrolyte which contains ions of the element which is to be transported through it. The electrodes consist of chromium, iron, lithium, sodium, cadmium, copper, or zinc and phosphorus, selenium, tellurium, sulfur, arsenic, or nitrogen. A method to heat the cathode in the regeneration cycle to transfer the electronegative component to the anode is provided. (RWR)

1381 SOLID-ELECTROLYTE CELL. Baukal, W. (to Battelle-Institute V.). German(FRG) Patent 2,017,128. 21 Oct 1971. Filed date 10 Apr 1970. 13p.
The electrolyte of this cell is $CaF_2$. It is doped anodically with a metal, preferably Ca,

and cathodically with a fluoride of a transition metal. Although completely solid, the cell has high available energy and is capable of many cycles. (RWR)

1382 CONTINUOUS MANUFACTURE OF TUBULAR TEXTILE RECEPTACLES, ESPECIALLY FOR LEAD--ACID STORAGE BATTERIES. Eigenmann, L. German(FRG) Patent 1,671,756. 21 Oct 1971. Filed date 3 Nov 1967. 34p.

Tubular receptacles were fabricated by curing polymer-impregnated polypropylene fabric in a flexible tube. The fabric was impregnated with an ether solution containing epoxies and then cured. Acrylic and Teflon fabrics were also tried, as were Vipla TJT, PVC, Acriplex 46, and Sicron 540 resins. (RWR)

1383 ELECTRIC CELL. Ito, H. British Patent 1,250,028. 20 Oct 1971. Filed date 31 Dec 1968. 4p.

Several cells are described which can be used in either the primary or secondary mode. The following combinations are discussed: positive carbon and negative zinc electrodes with $H_2NCONHSO_3H$ electrolyte and air or $MnO_2$ depolarizer; nickel and zinc electrodes with air depolarizer; iron and zinc electrodes with air depolarizer; and copper and zinc electrodes with CuO depolarizer. (RWR)

1384 SOLAR AND CHEMICAL SPACE POWER SYSTEM POTENTIAL. Woodward, W.H. (NASA, Washington, DC). Trans. Am. Nucl. Soc.; 14: No. 2, 540(Oct 1971).

From Joint meeting of the American Nuclear Society; Miami Beach, Fla. (17 Oct 1971).

SOLAR CELLS;SPACECRAFT POWER SUPPLIES; ELECTRIC BATTERIES

1385 RECHARGEABLE BATTERY CONTAINING A LITHIUM ANODE. Caiola, A.; Guy, H.; Sohm, J.C. (to Societe des Accumulateurs Fixes et de Traction). French Patent 2,068,146. 24 Sep 1971. Filed date 28 Nov 1969. 6p.

This battery has lithium and copper sulfate electrodes. The electrolyte is a mixture of $(Bu_4N)_2SO_4$ and $Bu_4NClO_4$ in methyl sulfate. (RWR)

1386 MERCURY (SODIUM AMALGAM)--OXYGEN FUEL CELL. Le Duc, J.A.M. (to Pullmann Inc.). German(FRG) Patent 1,596,205. 29 Jul 1971. Filed date 27 Sep 1966. 6p.

A battery is described which comprises electrodes with means for supplying liquid amalgam, positive gas diffusion electrodes with oxidizing agent, and an aqueous electrolyte. The gas diffusion electrodes occupy the middle portion of the cell. The lower part functions as a collecting basin for liquid Na amalgam; it has a lower outlet for the amalgam and an upper outlet for electrolyte. (RWR)

1387 HIGH-RATE NONAQUEOUS LITHIUM BATTERY. Eisenberg, M.; Wong, K. (Electrotechnica Corp., Menlo Park, CA). J. Hydronaut.; 5: No. 3, 97-100(Jul 1971).

Organic aprotic solvent electrolyte, 30 to 62 Wh/lb in 5-Ah cells lasting up to an hour. LITHIUM-COPPER CHLORIDE BATTERIES;ORGANIC COMPOUNDS;SOLVENTS;ELECTROLYTES;PERFORMANCE

1388 HIGH-RATE NONAQUEOUS LITHIUM BATTERY. Eisenberg, M.; Wong, K. (Electrotechnica Corp., Menlo Park, CA). J. Hydronaut.; 5: No. 3, 97-100(Jul 1971).

The theoretical basis of high-energy-density nonaqueous batteries is discussed with particular attention to the merits of lithium as an anode material. The development of a high-rate, high-energy nonaqueous battery is described. The electrochemical system employs lithium metal anodes and cupric chloride cathodes with an organic aprotic solvent electrolyte. The system has a theoretical energy density of 503 Wh/lb compared to 208 for the silver--zinc system, one of the highest-energy-density systems employed. Developmental efforts have gone primarily into the establishment of high rate capabilities with efficient performance over the range of rates from 10 to 60 min. Over this range of rates, for small 5-Ah cells, the energy density (in Wh/lb) improvement over the silver--zinc system ranges from 40 to almost 100%. Energy densities of 30 to 62 Wh/lb were demonstrated at discharge rates of 10 to 60 min for small-size 4- to 6-Ah cells. Some implications for future design of high-energy reserve-type batteries are discussed.

1389 HYDROGEN--AIR/LEAD BATTERY HYBRID SYSTEM FOR VEHICLE PROPULSION. Kordesch, K.V. (Union Carbide Corp., Parma, OH). J. Electrochem. Soc.; 118: No. 5, 812-17(May 1971).

6 kW hydrogen--air fuel cell and 4 kW/hr lead battery. HYBRID ELECTRIC-POWERED VEHICLES; HYDROGEN FUEL CELLS;AIR;LEAD-ACID BATTERIES; HYDROGEN STORAGE;TANKS;DESIGN;PERFORMANCE

1390 ZINC--AIR ALKALINE BATTERY. Hladik, O. (to Kombinat VEB Galvanische Elemente). French Patent 2,049,655. 30 Apr 1971. Filed date 16 Jun 1969. 4p.

The novel feature of this battery is that it uses a ZnO-free electrolyte or, alternatively, a special neutral electrolyte for the charging process and a different electrolyte for operation. Electrolytes can be transferred among various compartments. In this way the deleterious effects of the carbon electrode are eliminated. (RWR)

1391 SEALING POLYPROPYLENE OR ITS COPOLYMER COMPONENTS OF STORAGE BATTERIES. (to Societe Industrielle des Comprimes de l'Quest). French Patent 2,046,656. 9 Apr 1971. Filed date 20 May 1970. 4p.

Battery covers, vats, and accessories of polypropylene or its copolymers can be sealed with sealants such as bitumen, ebonite, or polystyrene by pretreating the surface with a chromic acid bath or an oxidizing flame. (RWR)

1392 COMPARATIVE EVALUATION OF POWER SYSTEM TYPES OF UNDERSEAS APPLICATIONS. Wimmer, R.E. Isot. Radiat. Technol.; 9: No. 2, 235-7(Win 1971).

Batteries, fuel cells, radioisotope batteries, and reactors. UNDERWATER;POWER SUPPLIES;COMPARATIVE EVALUATIONS;ELECTRIC BATTERIES;FUEL CELLS;RADIOISOTOPE BATTERIES; SNAP REACTORS

1393 (N--74-16817) REVERSIBILITY OF LEAD ELECTRODES IN ALKALINE ELECTROLYTES. Sidorov, V.A.; Flerov, V.N. Translated from Izv. Vyssh. Uchebn. Zaved., Khim. Khim. Tekhnol.; 14: No. 9, 1393-1396(1971). 8p. (AD--770533; FSTC-HT--23-1014-73). NTIS.

Ag/Pb storage battery. METAL-METAL BATTERIES; SILVER;LEAD;ELECTRODES;ELECTROLYTES;PERFORMANCE

1394 EXPERIMENTAL VEHICULAR ZINC--AIR BATTERY WITH REPLACEABLE ANODES. Witherspoon, R.R.; Zeitner, E.J.; Schulte, H.A. (General Motors Corp., Detroit). pp 96-102 of 6th Intersociety energy conversion engineering conference. New York; Society of Automotive Engineers, Inc. (1971).
From 6. Intersociety energy conversion engineering conference; Boston, MA (3 Aug 1971).
ZINC-AIR BATTERIES;DESIGN;FABRICATION; PERFORMANCE TESTING;CATHODES;ANODES;ELECTRIC-POWERED VEHICLES;AUTOMOBILES

1395 FABRICATION AND INITIAL TESTING OF AN EXPERIMENTAL ZINC--OXYGEN BATTERY FOR ELECTRIC VEHICLES. Caprioglio, G.; Weinberg, A. (Gulf General Atomic Co., San Diego, CA). pp 140-146 of 6th Intersociety energy conversion engineering conference. New York; Society of Automotive Engineers, Inc. (1971).
From 6. Intersociety energy conversion engineering conference; Boston, MA (3 Aug 1971).
ZINC-AIR BATTERIES;OXYGEN;FABRICATION; TESTING;ELECTRIC-POWERED VEHICLES;DESIGN; FEASIBILITY STUDIES;COST;AUTOMOBILES

1396 CHARACTERISTICS OF A TELLURIUM--LITHIUM/ ALUMINUM BATTERY. Metcalfe, J.E. III; Chaney, E.J.; Rightmire, R.A. pp 685-689 of 6th Intersociety energy conversion engineering conference. New York; Society of Automotive Engineers, Inc. (1971).
From 6. Intersociety energy conversion engineering conference; Boston, MA (3 Aug 1971).
LiAl/KCl--LiCl/C with Te halide additive. ELECTRIC-POWERED VEHICLES;OFF-PEAK ENERGY STORAGE;MOLTEN SALTS;METAL-NONMETAL BATTERIES; LITHIUM ALLOYS;ALUMINIUM ALLOYS;POTASSIUM CHLORIDES;LITHIUM CHLORIDES;CARBON;FABRICATION; TESTING;BATTERY CHARGERS;ELECTRIC POTENTIAL; TIME DEPENDENCE;TELLURIUM HALIDES

1397 SPACE TECHNOLOGY APPLICABLE TO HYBRID VEHICLE BATTERIES. Schwartz, H.J. (National Aeronautics and Space Administration, Cleveland). pp 690-694 of 6th Intersociety energy conversion engineering conference. New York; Society of Automotive Engineers, Inc. (1971).
From 6. Intersociety energy conversion engineering conference; Boston, MA (3 Aug 1971).
Development of silver--zinc cell with inorganic separator. BATTERY SEPARATORS;HYBRID ELECTRIC-POWERED VEHICLES;AUTOMOBILES;NICKEL-ZINC BATTERIES;PLANNING;ANODES;SPACE VEHICLES; SILVER-ZINC BATTERIES;PERFORMANCE

1398 EXPERIMENTAL VEHICULAR ZINC-AIR BATTERY WITH REPLACEABLE ANODES. Witherspoon, R.R.; Zeitner, E.J.; Schulte, H.A. (General Motors Corp., Warren, MI). pp 96-102 of 1971 intersociety energy conversion engineering conference. New York; Society of Automotive Engineers, Inc. (1971).
From Intersociety energy conversion engineering conference; Boston, MA (3 Aug 1971).
35 kWh, 10 W/lb at 30 mph, 28 kWh and 27 W/lb at 55 mph. ELECTRIC-POWERED VEHICLES;ZINC-AIR BATTERIES;ANODES;DESIGN;HYBRID ELECTRIC-POWERED VEHICLES;CATALYSTS;CATHODES;PERFORMANCE; AUTOMOBILES

1399 FABRICATION AND INITIAL TESTING OF AN EXPERIMENTAL ZINC--OXYGEN BATTERY FOR ELECTRIC VEHICLES. Caprioglio, G.; Weinberg, A. (Gulf General Atomic Co., San Diego, CA). pp 140-146 of 1971 intersociety energy conversion engineering conference. New York; Society of Automotive Engineers, Inc. (1971).
From Intersociety energy conversion engineering conference; Boston, MA (3 Aug 1971).
ELECTRIC-POWERED VEHICLES;ZINC-AIR BATTERIES; FABRICATION;TESTING;DESIGN;BATTERY CHARGERS; COST;SPECIFICATIONS

1400 CHARACTERISTICS OF A TELLURIUM--LITHIUM/ ALUMINUM BATTERY. Metcalfe, J.E. III; Chaney, E.J.; Rightmire, R.A. pp 685-689 of 1971 intersociety energy conversion engineering conference. New York; Society of Automotive Engineers, Inc. (1971).
From Intersociety energy conversion engineering conference; Boston, MA (3 Aug 1971).
Li--Al anode/KCl--LiC/C cathode with Te tetrachloride additive, 36 W-hr/lb. METAL-NONMETAL BATTERIES;LITHIUM ALLOYS;ALUMINIUM ALLOYS;POTASSIUM CHLORIDES;LITHIUM CHLORIDES; CARBON;TELLURIUM;TELLURIUM CHLORIDES;HIGH TEMPERATURE;ELECTRIC-POWERED VEHICLES;HYBRID ELECTRIC-POWERED VEHICLES;OFF-PEAK ENERGY STORAGE;FABRICATION;TESTING

1401 SPACE TECHNOLOGY APPLICABLE TO HYBRID VEHICLE BATTERIES. Schwartz, H.J. (Lewis Research Center, Cleveland). pp 690-694 of 1971 intersociety energy conversion engineering conference. New York; Society of Automotive Engineers, Inc. (1971).
From Intersociety energy conversion engineering conference; Boston, MA (3 Aug 1971).
HYBRID ELECTRIC-POWERED VEHICLES;NICKEL-ZINC BATTERIES;PERFORMANCE;BATTERY SEPARATORS

1402 ADVANCES IN ELECTROCHEMISTRY AND ELECTROCHEMICAL ENGINEERING. VOLUME 8. ELECTROCHEMICAL ENGINEERING. Delahay, P.; Tobias, C.W. Chichester, Sussex, England; Wiley. Interscience (1971). vp.
Book. ELECTRIC BATTERIES;FUEL CELLS; THERMODYNAMICS;LEAD-ACID BATTERIES;HYDROCARBON FUEL CELLS;ELECTROCHEMISTRY

1403 CHEMICAL POWER FOR THE ELECTRIC CAR. Schneider, F.A. Chem. Weekbl.; 67: No. 45, 13-16(1971).
Battery requirements for an electric-powered town car are reviewed. Disadvantages of lead/acid, Ni/Cd, Ag/Zn, Na/S, and Zn/air batteries and the hydrogen fuel cell are pointed out. It is felt that an alkaline Ni K borate/Zn battery can achieve the 48 Wh/kg and 4 to 6 year lifetime required at a reasonable price. (RWR)

1404 SECONDARY, NONAQUEOUS SOLVENT BATTERY. Dunning, J.S.; Tiedemann, W.H.; Hsueh, L.; Bennion, D.N. (Univ. of California, Los Angeles). J. Electrochem. Soc.; 118: No. 12, 1886-1890(1971).
A room-temperature battery with nonaqueous organic solvent was developed. The cell contains a lithium negative, a graphite positive, and lithium perchlorate--dimethyl sulfite electrolyte. The cell has an open-circuit voltage of 4.5 V, and delivers 10 mA/cm$^2$ at 4 V. (RWR)

1405 LITHIUM ALLOYS--CHLORINE SECONDARY BATTERY. I. BASIC STUDIES ON A LITHIUM ALLOYS--CHLORINE SECONDARY BATTERY USING A

MOLTEN SALT AS THE ELECTROLYTE. Yoshizawa, S.; Takehara, Z.; Ito, Y.; Morimoto, S. (Kyoto Univ.). Denki Kagaku; 39: No. 10, 834-839(1971). (In Japanese).
The feasibility as an automobile battery of a Li(Zn, Sn, or Pb)/LiCl--KCl/C--$Cl_2$ battery is examined. The emf was somewhat less than that of a conventional Li/$Cl_2$ battery. Operating temperature was 450°, and the output energy density of the anode was about 130 Wh/kg. (RWR)

1406 LEAD--ACID CELL. Burbank, J.; Simon, A.C.; Willihnganz, E. (Naval Research Lab., Washington, DC). Adv. Eletrochem. Electrochem. Eng.; 8: 157-251(1971).
Recent research results, with their relevance to both fundamental electrochemistry and the problems associated with further practical exploitation, are discussed. This discussion will hopefully serve to stimulate further interest and investigation, in order that the maximum potentialities may ultimately be realized for this electrode system. 202 refs.

1407 LATEST TREND IN THE BATTERY MANUFACTURING FIELD IN JAPAN. Ishikawa, T.; Shimizu, K. (Furukawa Battery Co., Ltd., Yokohama, Japan). Denki Kagaku Oyobi Kogyo Butsuri Kagaku; 39: No. 7, 605-612(1971).
ELECTRIC BATTERIES;PRODUCTION;FABRICATION; REVIEWS

1408 ALKALINE MERCURIC OXIDE CELLS. Devanathan, M.V.; Ramasamy, N.; Aravamuthan, S.V.V.; John, P.N.; Sarangapani, S. (to Council of Scientific and Industrial Research (India)). Indian Patent 116,490. 26 Dec 1970. Filed date 25 Jun 1968. 8p.
Fabrication of a sealed cell is discussed. Anode and cathode consisted of a laminar metal matrix packed with amalgamated zinc and mercuric oxide, covered with cellulose paper, and soaked in potassium hydroxide. (RWR)

1409 RESEARCH INSTITUTE OF L'HYDRO-QUEBEC. Ingenieur (Montreal); 56: No. 260, 18-22(Nov 1970). (In German).
The Electrochemical Division carries out studies in the fields of production, distribution and sale of electric energy. This covers problems connected with fuel cells and batteries, as well as the design of electric cars. The high-power division plans the establishment of a test laboratory with capacitors providing 4 megajoules at 1050 Kv. Continuous three-phase supply of 7200 MVA and synthetic tests allowing a 7-fold equivalent power input are planned. The Division of Material Sciences carries out research on cable and transformer oils with particular attention to the relationship between the mechanism of the dielectric and the molecular structure. The division of mechanics and thermodynamics is concerned with overhead lines, cryogenic systems and thermal problems in the design of electric equipment. Applications of plasma physics for the generation, transport and utilization of electric energy forms the main line of the Basic Sciences Division.

1410 BATTERY EMERGENCY POWER SUPPLIES. Prescott, A. (Electric Power Storage Ltd., Manchester, Eng.). Works Eng.; 14-15, 18-20(Sep 1970).
The essential features of any emergency system are that it should be reliable, give instant emergency power, remain idle for long periods and then spring into action immediately upon supply failure, and require minimum maintenance. Because storage battery systems meet these requirements to the full, they are frequently chosen for emergency power supplies. Various types and makes of batteries are described.

1411 RESERVE BATTERIES FOR BELL SYSTEM USE. Koontz, D.E.; Feder, D.O.; Babusci, L.D.; Luer, H.J. Bell Syst. Tech. J.; 49: No. 7, 1253-1278(Sep 1970).
A new cylindrical lead--acid battery was developed to provide reserve power to sustain telephone service during power-failure conditions. The usage of batteries in the modern telephone plant is discussed, the difficulties encountered with existing cell designs are reviewed, special features of the new design are described in detail, and the scope of the overall development program is outlined.

1412 DRUM PROGRAMER UPS BATTERY PRODUCTION. Madden, D.G. (Gould Inc., Kankakee, IL). Instrum. Technol.; 17: No. 8, 67-71(Aug 1970).
Electromechanical drum programers for batch processes offer design simplicity, low cost, and program flexibility. They are especially suited for slow processes that place light demands on moving parts. It is reported that, when applied to a paste-mixing operation for lead--acid batteries, the programers increased plant capacity by 30 percent, and cost about half as much as a comparable relay sequencing system.

1413 SUMMARY OF PATENTS ON ORGANIC ELECTROLYTE BATTERIES. Jasinski, R. (Tyco Lab. Inc., Waltham, MA). J. Electroanal. Chem. Interfacial Electrochem.; 26: No. 2-3, 189-194(Jul 1970).
Thirty-six patents were issued prior to 1970 on nonaqueous-electrolyte batteries. Initially, magnesium was the negative electrode emphasized. More recently the alkali and the other alkaline earth metals received most attention. A wide variety of solvent--solute positive-plate systems were patented. Most of these are primary batteries, although some couples are claimed to be sufficiently reversible to form the basis of secondary batteries. The systems described include high-energy-density lithium batteries, in particular those employing propylene carbonate as the ionizing solvent.

1414 ALKALINE ZINC--AIR STORAGE BATTERY. Hladik, O. (to Kombinat VEB Galvanische Elemente). German(FRG) Patent 1,926,913. 25 Jun 1970. Filed date 24 Jun 1968. 6p.
This battery requires no separator. Zinc and carbon electrodes are located in one chamber, and electrolyte (with and without ZnO) is stored in two other chambers. Electrolyte with ZnO is used in the electrode chamber during discharge of the battery; it is replaced by electrolyte without ZnO during charging. Since there are no $Zn^{2+}$ ions in solution during charging, the formation of Zn dendrites is avoided. (RWR)

1415 THERMODYNAMIC PROCESSES OF ELECTROCHEMICAL ENERGY GENERATION. Geller, Z.I.; Dontsov, G.V. (Odessa Technol. Inst. of the Food and Refrigeration Industry). Izv. Vyssh. Uchebn. Zaved., Energ.; No. 4, 68-74(Apr 1970). (In Russian).
FUEL CELLS;ELECTRIC BATTERIES;THERMODYNAMICS; TEMPERATURE DEPENDENCE

1416 RECENT PROGRESS IN BATTERIES. Fukuda, M. Natl. Tech. Rep. (Matsushita Electr. Ind. Co., Osaka); 16: No. 2, 145-180(Apr 1970). (In Japanese).
This review is focused on advances in various batteries developed during the last several years, with prospective views for the future. In the field of electrochemical batteries, marked progress has been made in highly-powered, cordless and maintenance-free performance. Regarding new types of batteries, fuel cells will soon be practically applied not only for aerospace demands but also civil ones. Metallic lithium and sodium have been tried as anode materials for high-energy-density batteries. Also, some electrochemical systems were proposed.

1417 SEALED LEAD--ACID BATTERY ''HI-SEAL'' FOR STATIONARY USE. Miura, T.; Takahashi, K.; Fukuda, M. Natl. Tech. Rep. (Matsushita Electr. Ind. Co., Osaka); 16: No. 2, 230-237(Apr 1970). (In Japanese).
A new type of sealed maintenance-free lead--acid battery for stationary use was developed. The so-called ''third electrode'' was applied, which catalytically reduces evolved gases into water and thus prevents both gases from exhausting and electrolytes from decreasing. Because of the successful development of the ''third electrode'' of long service life, as well as the adoption of a nonlinear resistor for control of the potential of the ''third electrode'', a sealed battery of long service life was realized. This battery is used principally on floating charge condition.

1418 ROUND SHAPE DOUBLES BATTERY LIFE. Mech. Eng.; 92: No. 1, 41(Jan 1970).
LEAD-ACID BATTERIES;CYLINDRICAL CONFIGURATION;LIFETIME;DESIGN;PERFORMANCE

1419 SESSION ON REQUIREMENTS FOR POWER SOURCES: NASA. Schulman, F. (NASA, Washington, DC). pp 75-7 of Proceedings of the 24th Power Sources Symposium. Red Bank, NJ; PSC Publications Committee (1970).
From 24. Power Sources Symposium; Fort Monmouth, NJ (19 May 1970).
SOLAR CELL ARRAYS;ELECTRIC BATTERIES; THERMOELECTRIC GENERATORS;FUEL CELLS;SPACE POWER REACTORS;SPACECRAFT POWER SUPPLIES; SPECIFICATIONS

1420 DESIGN AND PERFORMANCE OF THE TACSAT POWER SUBSYSTEM. Levy, E., Jr. (Hughes Aircraft Co., El Segundo, CA). pp 13.1-9 of Energy 70, Proceedings. Vol. 2. Hinsdale, IL; Amer. Nucl. Soc. (1970).
From 5. annual intersociety energy conversion engineering conference; Las Vegas, Nevada, USA (21 Sep 1970).
SOLAR CELL ARRAYS;SPACECRAFT POWER SUPPLIES; DESIGN;PERFORMANCE;ELECTRONIC EQUIPMENT; ELECTRIC BATTERIES

1421 DEVELOPMENT OF LITHIUM/SELENIUM SECONDARY CELLS AND BATTERIES FOR IMPLANTATION. Shimotake, H.; Chilenskas, A.A.; Steunenberg, R.K.; Cairns, E.J. (Argonne National Lab., Argonne, IL). pp 3-61 to 3-66 of Energy 70, Proceedings. Intersociety Energy Conversion Engineering Conference. Volume 1. Hinsdale, IL; American Nuclear Society (1970).
From 5. annual intersociety energy conversion engineering conference; Las Vegas, Nevada, USA (21 Sep 1970).
Electrolyte = LiF--LiCl--LiI + $LiAlO_2$. METAL-NONMETAL BATTERIES;LITHIUM;SELENIUM;IN VIVO; ARTIFICIAL ORGANS;MECHANICAL HEART;LITHIUM FLUORIDES;LITHIUM CHLORIDES;LITHIUM IODIDES; ALUMINATES;LITHIUM COMPOUNDS;PERFORMANCE

1422 HIGH ENERGY DENSITY NICKEL--CADMIUM CELLS. Charkey, A.; Klein, M. (Energy Research Corp., Bethel, CT). pp 5-1 to 5-5 of Energy 70, Proceedings. Intersociety Energy Conversion Engineering Conference. Volume 1. Hinsdale, IL; American Nuclear Society (1970).
From 5. annual intersociety energy conversion engineering conference; Las Vegas, Nevada, USA (21 Sep 1970).
NICKEL-CADMIUM BATTERIES;FABRICATION;TESTING; PERFORMANCE;ELECTRODES;POLARIZATION

1423 HIGH ENERGY DENSITY LONG LIFE SECONDARY SILVER--ZINC BATTERIES. Wilson, J.K.; Standlee, D. (Eagle-Picher Industries, Inc., Joplin, MO); Kinsey, R.H.; Self, S.R. (Lockheed Missiles and Space Co., Sunnyvale, CA). pp 5-9 to 5-14 of Energy 70, Proceedings. Intersociety Energy Conversion Engineering Conference. Volume 1. Hinsdale, IL; American Nuclear Society (1970).
From 5. annual intersociety energy conversion engineering conference; Las Vegas, Nevada, USA (21 Sep 1970).
SILVER-ZINC BATTERIES;SILVER OXIDES;DESIGN; PLATES;OPTIMIZATION;THERMAL TESTING;PERFORMANCE TESTING;SATELLITES

1424 BIOSATELLITE FUEL CELL/BATTERY POWER SYSTEM. Bruhin, A.C.; Bennett, C.W. Proceedings of 1st Western Space Congress, Santa Maria, CA, 27-29 Oct 1970. Santa Maria; Western Space Congress (1970).
From 1. Western Space Congr.; Santa Maria, CA (27-29 Oct 1970).
HYDROGEN FUEL CELLS;OXYGEN;SILVER-ZINC BATTERIES;SPACECRAFT POWER SUPPLIES;POWER CONDITIONING CIRCUITS;OPTIMIZATION

1425 HIGH ENERGY DENSITY, LONG LIFE ZN--AGO SECONDARY BATTERY BB-534( )/U. Settembre, E.J. pp 10-13 of 24th power sources symposium. Red Bank, NJ; PSC Publications Committee (1970).
From 24. power sources symposium; Fort Monmouth, NJ (19 May 1970).
Assembly of four 9.0-A, 4-cell blocks into 24-v batteries. SILVER-ZINC BATTERIES;ELECTRIC POTENTIAL;DESIGN;PERFORMANCE TESTING;PLANNING

1426 SOLID STATE ENERGY STORAGE DEVICE. Oxley, J.E. pp 20-23 of 24th power sources symposium. Red Bank, NJ; PSC Publications Committee (1970).
From 24. power sources symposium; Fort Monmouth, NJ (19 May 1970).
$Ag/RbAg_4I_5/C$, 0.5 V, highly capacitive device, recyclable thousands of times. ELECTRIC BATTERIES;CAPACITORS;RUBIDIUM IODIDES;SILVER IODIDES;SILVER;CARBON;PERFORMANCE

1427 BATTERIES OF THE FUTURE. Takahashi, T. (Fac. Eng. Nagoya Univ., Nagoya, Japan). Kagaku (Kyoto); 25: No. 2, 104-11(1970).
PHOTOVOLTAIC CELLS;THERMOELECTRIC GENERATORS; THERMIONIC CONVERTERS;RADIOISOTOPE BATTERIES; ELECTRIC BATTERIES;FUEL CELLS

1428 IT IS STILL POSSIBLE TO INVENT AN ELECTROCHEMICAL GENERATOR. Sohm, J.C. Entropie; No. 33, 3-11(1970). (In French).
FUEL CELLS;ELECTRIC BATTERIES;RESEARCH

PROGRAMS;REVIEWS

1429 NEW CONCEPTS FOR RECHARGING ELECTROCHEMICAL BATTERIES. Linden, D. (US Army Electronics Command, Fort Monmouth, NJ). New York; ASME (1970). 7p.
From ASME meeting; (11-14 May 1970).
METAL-GAS BATTERIES;FUEL CELLS;ELECTRIC BATTERIES;BATTERY CHARGERS;BATTERY CHARGING; USES

1430 HIGH-ENERGY DENSITY LITHIUM--NICKEL FLUORIDE NON-AQUEOUS BATTERIES. Seiger, H.N.; Lyall, A.E.; Shair, R.C. (Gulton Industries Inc., Metuchen, NJ). pp 267-287 of Power sources 2. Research and development in non-mechanical electrical power sources. Collins, D.H. (ed.). Oxford; Pergamon Press Ltd. (1970).
From 6. international symposium on power sources 2; Brighton, Eng. (Sep 1968).
LITHIUM;NICKEL FLUORIDES;METAL-NONMETAL BATTERIES;MATERIALS;ELECTROCHEMISTRY;ELECTRODES; ELECTRIC POTENTIAL;PERFORMANCE;POLYPROPYLENE; CARBONIC ACID ESTERS;NITROBENZENE;DMSO;ORGANIC COMPOUNDS;ELECTROLYTES;CHEMICAL REACTIONS

1431 SULFUR ELECTRODE. Coleman, J.R.; Bates, M.W. (Defence Chemical Biological and Radiation Establishment, Ottawa). pp 289-302 of Power sources 2. Research and developent in non-mechanical electrical power sources. Collins, D.H. (ed.). Oxford; Pergamon Press Ltd. (1970).
From 6. international symposium on power sources 2; Brighton, Eng. (Sep 1968).
Li(Ni)/DMSO--$KClO_4$/S--C(M). LITHIUM-SULFUR BATTERIES;GRAPHITE;CATHODES;DMSO;POTASSIUM COMPOUNDS;PERCHLORATES;LACTONES;THIOCYANATES

1432 SOME NEW REFILL CELL SYSTEMS. Boter, P.A. (Philips' Research Labs., Eindhoven, Netherlands); Wijnen, M.D.; Nuyens, H.L.C. pp 359-371 of Power sources 2. Research and developent in non-mechanical electrical power sources. Collins, D.H. (ed.). Oxford; Pergamon Press Ltd. (1970).
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Mechanically or chemically rechargeable; fairly low output. ELECTRIC BATTERIES; PERFORMANCE;FABRICATION;ELECTRIC CURRENTS;TIME DEPENDENCE;CARBON;FIBERS;PAPER;POWDERS;SHEETS; POTASSIUM COMPOUNDS;PEROXIDES;SULFATES; PEROXIDES;SULFATES;DESIGN;ELECTRIC POTENTIAL; NICKEL;SODIUM COMPOUNDS

1433 ZINC--AIR BATTERY SYSTEMS. Chodosh, S.M.; Jagid, B.; Katsoulis, E. pp 423-440 of Power sources 2. Research and development in non-mechanical electrical power sources. Collins, D.H. (ed.). Oxford; Pergamon Press Ltd. (1970).
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1434 AIR--METAL CELL SYSTEMS. Goualard, J.; Harivel, J.P. (Fundamental Research Lab., Romainville, France). pp 441-460 of Power sources 2. Research and development in non-mechanical electrical power sources. Collins, D.H. (ed.). Oxford; Pergamon Press Ltd. (1970).
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1435 FUEL CELL--BATTERY POWER SOURCES. Frysinger, G.R.; Wrublewski, F. (Army Electronics Command, Fort Monmouth, NJ). pp 567-581 of Power sources 2. Research and development in non-mechanical electrical power sources. Collins, D.H. (ed.). Oxford; Pergamon Press Ltd. (1970).
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1436 THERMAL AND MECHANICAL DESIGN OF NICKEL CADMIUM AEROSPACE BATTERIES. Thierfelder, H. (General Electric Co., Philadelphia); Wylie, T. New York; American Society of Mechanical Engineers (1970). 8p.
The thermal and mechanical design of a number of aerospace batteries which have been used in the space programs are compared. The nickel--cadmium batteries used in the TIROS, Nimbus, Advent, Relay, lunar Orbiter, TOS, NAVSAT, and 1 TOS programs are described and discussed. It is concluded that the unique requirements of each space program have led to the wide variations in basic battery designs.

1437 DESIGN OF A 25 AMPERE-HOUR, HEAT-STERILIZABLE, HIGH-IMPACT, SILVER--ZINC CELL. Purcell, T.H. Jr. (ESB Inc., Raleigh, NC); Jordan, A.W. New York; American Society of Mechanical Engineers (1970). 8p.
Future spacecraft missions may require a high impact capability in order to land instrument packages on the surfaces of other celestial bodies. Sealed silver--zinc cells are being considered as the source of spacecraft power. The present design goal for impact capability is 4000 earth g's. An additional restraint, that the cells must also be heat sterilizable, means that the cell must operate successfully after exposure to 135 C for a minimum of 72 hr. The present design philosphy is to reinforce the cell electrodes with metal structure and transfer the stock loads into slots located in the plastic jar wall.

1438 REVERSIBLE SOLID-STATE BATTERY WITH $RbAg_4I_5$ AS ELECTROLYTE. De Rossi, M. (Univ., Rome); Pistoia, G.; Scrosati, B. J. Electrochem. Soc.; 116: No. 12, 1642-1646(Dec 1969).
ELECTRIC BATTERIES;ELECTROLYTES;SOLIDS;SPACE VEHICLES;SILVER IODIDES;RUBIDIUM IODIDES; ELECTRONIC CIRCUITS;COST;FABRICATION

1439 ALKALINE BATTERIES. Cotton, M.B. Compon. Technol.; 4: No. 2, 13-17(Nov 1969).
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1440 PHASE EQUILIBRIUM STUDIES OF LITHIUM HALIDE-CONTAINING ELECTROLYTES. Johnson, C.E.; Foster, M.S. (Argonne National Lab., IL). J. Electrochem. Soc.; 116: No. 11, 1612-1613(Nov 1969).
The application of fused-salt mixtures as electrolytes in electrochemical cells has resulted in increased interest in their

physical and chemical properties. A knowledge of these properties is important in selecting appropriate electrolytes, since the choice depends on a variety of factors. One of the salt systems being considered for use as an electrolyte in lithium-anode galvanic cells is LiCl--LiI--KI. This system was chosen for investigation after a preliminary examination had indicated that it had a minimum melting point of 264 C, one of the lowest observed for ternary alkali halide mixtures. The good agreement between the calculated and experimental values and the few experiments required to obtain the necessary data makes it clear that the conformal ionic solution theory offers significant saving of experimental effort in the slection of low-melting-point electrolyte mixtures.

1441 METAL--OXYGEN FUEL CELL. Jagid, B.; Rosansky, M.G. (to Leesona Corp.). US Patent 3,468,711. 23 Sep 1969. Filed date 15 Mar 1966. vp.
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1442 CATHODIC OXYGEN REDUCTION IN THE SEALED LEAD--ACID CELL. Hills, S. (General Electric Co., Philadelphia); Chu, D.L.K. J. Electrochem. Soc.; 116: No. 8, 1155-1160(Aug 1969).
LEAD-ACID BATTERIES;OXYGEN;BATTERY SEPARATORS;REDUCTION;CHEMICAL REACTIONS;SEALS; ANODES;DESIGN;ELECTROLYTES

1443 HIGH-TEMPERATURE BATTERIES. Cairns, E.J.; Shimotake, H. (Argonne National Lab., IL). Science; 164: No. 3886, vp(20 Jun 1969).
Recent developments in compact, powerful cells for electric-powered vehicles, etc. HIGH TEMPERATURE;ELECTRIC BATTERIES;REVIEWS; ELECTROCHEMISTRY;FUEL CELLS;METAL-GAS BATTERIES; LITHIUM-CHLORINE BATTERIES;SODIUM-SULFUR BATTERIES;LITHIUM-SULFUR BATTERIES;ELECTRIC-POWERED VEHICLES

1444 SECONDARY CADMIUM--AIR CELLS. Wagner, O.C. (Army Electronics Command, Fort Monmouth, NJ). J. Electrochem. Soc.; 116: No. 5, 693-698(May 1969).
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1445 NEW CLASS OF ELECTRIC BATTERIES AND ''COMPENSATED DIFFUSION'' PHENOMENON. Marinesco, M. C. R. Hebd. Seances Acad. Sci., Ser. C; 268: No. 17, 1492-1495(28 Apr 1969). (In French).
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1446 NICKEL--CADMIUM STORAGE BATTERIES FOR SUPPLY OF METEOROLOGICAL BALLOONS. Monneret, B.; Du Plessix, M.; Courtot, J.P. Rev. Gen. Electr.; 78: No. 4, 371-378(Apr 1969). (In French).
NICKEL-CADMIUM BATTERIES;DESIGN;PACKAGING; METEOROLOGY;FLEXIBILITY;RADIO EQUIPMENT POWER SUPPLIES;BALLOONS

1447 (AD--694885) DESCRIPTIONS OF INVENTIONS. Feb 1969. Translation of a collection of Soviet patents. (FTD-HT--23-644-68). 46p. NTIS.
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1448 SECONDARY SILVER--ZINC BATTERY TECHNOLOGY. Gaines, L. (Tyco Labs., Inc., Waltham, MA). J. Electrochem. Soc.; 116: No. 2, 61C-67C(Feb 1969).
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1449 FUEL BATTERY-RECHARGEABLE ACCUMULATOR COMBINATION. Hovious, T.C. (to General Electric Co., New York). US Patent 3,423,599. 21 Jan 1969. Filed date 20 Sep 1965.
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1451 INTERNAL ENERGY STORAGE FOR CIRCULATORY ASSIST DEVICES. Hamlen, R.P.; Siwek, E.G. (General Electric Research and Development Center, Schenectady, NY); Rampel, G. (General Electric Battery Business Section, Gainesville, FL); Wechsler, L.D.; Zampini, J. (General Electric Electronics Lab., Syracuse, NY). pp 339-45 of Proceedings of the 4th Intersociety Energy Conversion Engineering Conference, September 22-26, 1969, Washington, DC. New York; American Institute of Chemical Engineers (1969).
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1452 SECONDARY CELLS WITH LITHIUM ANODES AND PASTE ELECTROLYTES. Shimotake, H.; Fischer, A.K.; Cairns, E.J. (Argonne National Lab., Chemical Engineering Div., Argonne, IL). pp 538-47 of Proceedings of the 4th Intersociety Energy Conversion Engineering Conference, September 22-26, 1969, Washington, DC. New York; American Institute of Chemical Engineers (1969).
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NICKEL-CADMIUM BATTERIES;AIRCRAFT;DESIGN

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NICKEL-CADMIUM BATTERIES;SAMPLING;AIRCRAFT; PERFORMANCE;LIFETIME;MAINTENANCE;QUALITY CONTROL;PERFORMANCE TESTING

1972 (AD--915259L) SAMPLING TESTS TWO TYPE MS 90365-2 NICKEL--CADMIUM AIRCRAFT BATTERIES MANUFACTURED BY MARATHON BATTERY COMPANY UNDER CONTRACT N00019-72-C-0563. FINAL REPORT. (Naval Ammunition Depot, Crane, Ind. (USA)). Dec 1973. 11p. (QEEL/C--73-441). DDC.
NICKEL-CADMIUM BATTERIES;SAMPLING;AIRCRAFT; PERFORMANCE;LIFETIME;MAINTENANCE;QUALITY CONTROL;PERFORMANCE TESTING

1973 (AD--915260L) SAMPLING TESTS OF EIGHT TYPE MS 90321-86 NICKEL--CADMIUM CELLS, MANUFACTURED BY MARATHON BATTERY COMPANY UNDER CONTRACT N00383-72-C-2039. (Naval Ammunition Depot, Crane, Ind. (USA)). Dec 1973. 15p. (QEEL/C--73-442). DDC.
NICKEL-CADMIUM BATTERIES;LOW TEMPERATURE; NYLON;LIFETIME;ELECTRIC POTENTIAL;PERFORMANCE TESTING;LEVELS;MECHANICAL VIBRATIONS;IMPACT SHOCK

1974 (AD--915448L) H-3 HELICOPTER BATTERY SYSTEM INVESTIGATION. INTERIM REPORT NO. 1, APR-SEP 1973. (Naval Air Test Center, Patuxent River, Md. (USA)). Dec 1973. 9p. (NATC-WST--184R-73). DDC.
NICKEL-CADMIUM BATTERIES;AIRCRAFT;FAILURES; PERFORMANCE

1975 (AD--915478L) H-2 BATTERY SYSTEM INVESTIGATION. INTERIM REPORT NO. 1, APR--OCT 1973. (Naval Air Test Center, Patuxent River, Md. (USA)). Dec 1973. 21p. (NATC-WST--185R-73). DDC.
NICKEL-CADMIUM BATTERIES;AIRCRAFT;BATTERY CHARGERS;SPECIFICATIONS;PERFORMANCE TESTING; LIFETIME;IMPACT SHOCK;THERMODYNAMIC PROPERTIES; HUMIDITY;MECHANICAL VIBRATIONS;INTERFERENCE

1976 (AD--915568L) SAMPLING TESTS OF EIGHT TYPE MS90321-78W, NICKEL--CADMIUM BATTERY CELLS, REPRESENTING LOTS 1 THROUGH 8, MANUFACTURED BY GULTON INDUSTRIES, INC., UNDER CONTRACT N00383-73-C-0627. (Naval Ammunition Depot, Crane, Ind. (USA)). Nov 1973. 10p. (QEEL/C--73-447). DDC.
NICKEL-CADMIUM BATTERIES;PERFORMANCE TESTING; SAMPLING;LIFETIME;ELECTROLYTES;POTASSIUM HYDROXIDES

1977 (AD--915890L) QUALIFICATION OF GULTON INDUSTRIES, INC., TYPE MS90377-1 NICKEL--CADMIUM BATTERY, EMPLOYING MODIFIED LOW FREQUENCY VIBRATION TEST. (Naval Ammunition Depot, Crane, Ind. (USA)). Jan 1974. 15p. (QEEL/C--73-460). DDC.
NICKEL-CADMIUM BATTERIES;MECHANICAL VIBRATIONS;AIRCRAFT;ACCELERATION;ELECTRIC POTENTIAL;PERFORMANCE TESTING;LIFETIME;LEVELS; HUMIDITY;FUNGI

1978 (AD--916042L) T-28 BATTERY SYSTEM INVESTIGATION. FINAL REPORT APR--OCT 1973. (Naval Air Test Center, Patuxent River, Md. (USA)). Dec 1973. 6p. (NATC-WST--190R-73). DDC.
Need for replacing lead--acid by nickel--cadmium batteries. LEAD-ACID BATTERIES;

OPERATION;AIRCRAFT

1979 (AD--916361L) EVALUATION OF GOULD TYPE TLX-39B, GUPPY I MOD C (BLACK OXIDE) SUBMARINE MAIN STORAGE BATTERY CELLS BY THE '23-1' FLOAT-CHARGE PROCEDURE. FINAL REPORT. Miller, W.H. (Mare Island Naval Shipyard, Vallejo, Calif. (USA)). Nov 1973. 87p.
ELECTRIC BATTERIES;SUBMARINES;NUCLEAR SHIPS; LEAD ALLOYS;CESIUM ALLOYS;ELECTROLYTES;LIFETIME; ANODES;GRIDS;FABRICATION;PERFORMANCE TESTING

1980 (AD--916409L) FIRST ARTICLE TESTS OF TWO TYPE MS 17334-2, NICKEL--CADMIUM BATTERIES MANUFACTURED BY GULTON BATTERY CORPORATION UNDER CONTRACT N00383-72-C-5222. (Naval Ammunition Depot, Crane, Ind. (USA)). Jan 1974. 5p. (QEEL/C--74-30). DDC.
NICKEL-CADMIUM BATTERIES;PERFORMANCE TESTING; LIFETIME;AIRCRAFT;ELECTRIC POTENTIAL;BATTERY CHARGERS;CONNECTORS

1981 (AD--916410L) SAMPLING TESTS OF ONE TYPE MS 3319-1 NICKEL--CADMIUM BATTERY, MANUFACTURED BY GULTON BATTERY CORPORATION UNDER CONTRACT N00383-72-C-3184. (Naval Ammunition Depot, Crane, Ind. (USA)). Jan 1974. 10p. (QEEL/C--74-31). DDC.
NICKEL-CADMIUM BATTERIES;PERFORMANCE;TESTING; DIELECTRIC PROPERTIES;WEIGHT;INSPECTION; LIFETIME;LEVELS;IMPACT SHOCK;THERMAL SHOCK; MECHANICAL VIBRATIONS

1982 (AD--916497L) SAMPLING TESTS OF TWO TYPE MS 90321-86 NICKEL--CADMIUM CELLS, MANUFACTURED BY GULTON BATTERY CORPORATION UNDER CONTRACT N00383-72-M-3749. (Naval Ammunition Depot, Crane, Ind. (USA)). Jan 1974. 12p. (QEEL/C--74-3). DDC.
NICKEL-CADMIUM BATTERIES;PERFORMANCE TESTING; QUALITY CONTROL;ELECTRIC POTENTIAL;ELECTROLYTES; POTASSIUM HYDROXIDES;DEFECTS;LIFETIME;IMPACT SHOCK;MECHANICAL VIBRATIONS

1983 (AD--916499L) FIRST ARTICLE TESTS OF TWO 12-VOLT, TYPE MS 90379-1A LEAD--ACID BATTERIES, MANUFACTURED BY TELEDYNE INC., GILL ELECTRIC DIVISION, UNDER CONTRACT N00383-72-C-5202. FINAL REPORT. (Naval Ammunition Depot, Crane, Ind. (USA)). Jan 1974. 11p. (QEEL/C--74-28). DDC.
LEAD-ACID BATTERIES;TESTING;AIRCRAFT; DIELECTRIC PROPERTIES;THERMODYNAMIC PROPERTIES; LIFETIME;ELECTROLYTES;IMPACT SHOCK

1984 (AD--916703L) SAMPLING TESTS OF EIGHT TYPE MS 90321-86 NICKEL--CADMIUM CELLS, MANUFACTURED BY MARATHON BATTERY COMPANY, UNDER CONTRACT N00383-73-C-1216. (Naval Ammunition Depot, Crane, Ind. (USA)). Feb 1974. 13p. (QEEL/C--74-32). DDC.
NICKEL-CADMIUM BATTERIES;TESTING;PERFORMANCE; LIFETIME;LEVELS;LOW TEMPERATURE;IMPACT SHOCK; MECHANICAL VIBRATIONS;SAMPLING

1985 (AD--916826L) FIRST ARTICLE TESTING OF TWO TYPE MS 90344-1, NICKEL--CADMIUM BATTERIES, MANUFACTURED BY MARATHON BATTERY COMPANY UNDER CONTRACT N00383-73-C-0682. (Naval Ammunition Depot, Crane, Ind. (USA)). Feb 1974. 18p. (QEEL/C--74-35). DDC.
30 percent KOH electrolyte. NICKEL-CADMIUM BATTERIES;TESTING;PERFORMANCE;AIRCRAFT; ACCELERATION;DIELECTRIC PROPERTIES;LEAKS;AIR; LIFETIME;MECHANICAL VIBRATIONS;POTASSIUM HYDROXIDES

1986 (AD--917329L) SAMPLING AND LIFE CYCLE COSTING TESTS OF TYPE MS 18045-42, LEAD--ACID, AIRCRAFT BATTERIES FROM 22 PRODUCTION LOTS MANUFACTURED BY TELEDYNE INC., TELEDYNE BATTERY PRODUCTS DIVISION UNDER CONTRACT N00383-72-C-4027. (Naval Ammunition Depot, Crane, Ind. (USA)). Mar 1974. 19p. (QEEL/C--74-75). DDC.
LEAD-ACID BATTERIES;AIRCRAFT;PERFORMANCE TESTING;SAMPLING;COST;LIFETIME;ECONOMICS

1987 (AD--917330L) FIRST ARTICLE TESTING OF TWO TYPE MS90321-79W NICKEL--CADMIUM CELLS, MANUFACTURED BY MARATHON BATTERY COMPANY UNDER CONTRACT N00383-73-C-0683. (Naval Ammunition Depot, Crane, Ind. (USA)). Mar 1974. 11p. (QEEL/C--74-76). DDC.
NICKEL-CADMIUM BATTERIES;AIRCRAFT; SPECIFICATIONS;PERFORMANCE TESTING;LIFETIME

1988 (AD--917331L) FIRST ARTICLE TESTS OF TWO TYPE MS18045-45 NICKEL--CADMIUM BATTERIES, MANUFACTURED BY GULTON BATTERY CORPORATION UNDER CONTRACT N00383-73-C-0819. (Naval Ammunition Depot, Crane, Ind. (USA)). Mar 1974. 13p. (QEEL/C--74-118). DDC.
NICKEL-CADMIUM BATTERIES;RELIABILITY; AIRCRAFT;LIFETIME;DIELECTRIC PROPERTIES;IMPACT SHOCK;CONTAINERS;TESTING

1989 (AD--917332L) SAMPLING TESTS OF ONE TYPE MS90365-2 NICKEL--CADMIUM BATTERY, MANUFACTURED BY GULTON BATTERY CORPORATION UNDER CONTRACT N00383-73-C-0135. (Naval Ammunition Depot, Crane, Ind. (USA)). Mar 1974. 13p. (QEEL/C--74-121). DDC.
NICKEL-CADMIUM BATTERIES;SAMPLING; PERFORMANCE TESTING;ELECTRICAL PROPERTIES; DIELECTRIC MATERIALS;SPECIFICATIONS;RELIABILITY

1990 (AD--917455L) TEST AND EVALUATION OF THE OHIO AIR-VAC TRANSPORT INCUBATOR FOR USE IN AEROMEDICAL AIRLIFT. FINAL REPORT 1972--73. Buchanan, H. (School of Aerospace Medicine, Brooks AFB, Tex. (USA)). Dec 1973. 20p. (SAM-TR--73-48). DDC.
INCUBATION;MEDICAL SUPPLIES;INFANTS;NICKEL-CADMIUM BATTERIES;PERFORMANCE;PERFORMANCE TESTING;SAFETY;ELECTROMAGNETIC FIELDS; INTERFERENCE;LEVELS;HUMIDITY;CARBON DIOXIDE; OXYGEN;CHEMICAL COMPOSITION;QUANTITY RATIO; AIRCRAFT;HAZARDS

1991 (AD--917732L) SAMPLING TESTS OF 17 TYPE MS90321-66W NICKEL--CADMIUM CELLS, MANUFACTURED BY MARATHON BATTERY COMPANY UNDER CONTRACT N00383-73-C-2016. (Naval Ammunition Depot, Crane, Ind. (USA)). Mar 1974. 13p. (QEEL/C--74-205). DDC.
KOH electrolyte. NICKEL-CADMIUM BATTERIES; NYLON;AIRCRAFT;CONTAINERS;VENTS;VALVES; POTASSIUM HYDROXIDES;SAMPLING;PERFORMANCE TESTING

1992 (AD--917760L) SAMPLE TESTING OF FIVE 12-VOLT, TYPE MS90379-1, LEAD--ACID BATTERIES MANUFACTURED BY TELEDYNE BATTERY PRODUCTS, A DIVISION OF TELEDYNE, INC., UNDER CONTRACT N00383-72-C-5202. FINAL REPORT. (Naval Ammunition Depot, Crane, Ind. (USA)). Mar 1974. 13p. (QEEL/C--74-77). DDC.
LEAD-ACID BATTERIES;TESTING;AIRCRAFT;QUALITY CONTROL;PRODUCTION;PLATES;FAILURES;LIFETIME; DECOMPOSITION;SPECIFICATIONS;ELECTRIC POTENTIAL; DIELECTRIC PROPERTIES;PHYSICAL PROPERTIES; MECHANICAL TESTS;WEIGHT;SAMPLING

1993 (AD--918123L) SAMPLING TESTS OF ONE TYPE MS18045-74 NICKEL--CADMIUM BATTERY, MANUFACTURED BY MARATHON BATTERY COMPANY UNDER CONTRACT N00383-73-C-1824. (Naval Ammunition Depot, Crane, Ind. (USA)). Apr 1974. 12p. (QEEL/C--74-207). DDC.
NICKEL-CADMIUM BATTERIES;PERFORMANCE; LIFETIME;ELECTRICAL PROPERTIES;MECHANICAL VIBRATIONS;THERMAL SHOCK;HUMIDITY;FUNGI;LEVELS; AIRCRAFT;POTASSIUM HYDROXIDES

1994 (AD--919148L) DEVELOPMENT OF STABLE ZINC ELECTRODES AND INORGANIC SEPARATORS FOR USE IN SUBMARINE TYPE SILVER--ZINC CELLS. INTERIM REPORT 15 MAR 1973--15 MAR 1974. Charkey, A. (Energy Research Corp., Bethel, Conn. (USA)). Mar 1974. Contract N00024-73-C-5346. 27p. DDC.
SILVER-ZINC BATTERIES;ZINC;ELECTRODES; BATTERY SEPARATORS;SUBMARINES;PERFORMANCE; ANODES;CATHODES;DECOMPOSITION;LIFETIME;ORGANIC FLUORINE COMPOUNDS;POTASSIUM COMPOUNDS; HYDROXIDES;TITANATES;ELECTROCHEMISTRY

1995 (AD--919263L) SERVICE TEST OF ZINC--AIR BATTERY, BA-536( )/U. FINAL REPORT, JAN-MAR 1973 AND JUL-OCT 1973. Smith, R.E. (Army Airborne Electronics and Special Warfare Board, Fort Bragg, N.C. (USA) ). Nov 1973. 50p. (USAACEBD-CE--1770). DDC.
ZINC-AIR BATTERIES;PERFORMANCE;ANODES;POWER SUPPLIES;SAFETY;RELIABILITY;LIFETIME; PERFORMANCE TESTING;RADAR

1996 (AD--921643) EFFECT OF CATIONIC IMPURITIES ON THE SILVER--SILVER OXIDE ELECTRODE: THE SILVER--COPPER--IRON--PALLADIUM SYSTEM. Bedwell, M.E. (Royal Aircraft Establishment, Farnborough (UK)). [nd]. 109p. (RAE-TR--73181).
SILVER-ZINC BATTERIES;SILVER-CADMIUM BATTERIES;ELECTRODES;IMPURITIES;SILVER OXIDES; PALLADIUM;COPPER;IRON;SUBSTRATES;NICKEL

1997 (AD--A032299) A REVIEW OF MATERIALS AND MECHANISMS WHICH AFFECT THE PERFORMANCE OF LEAD--ACID STORAGE BATTERIES. INTERIM REPORT JUN--SEP 76. Perkins, J.; Pokorny, J.L.; Coyle, M.T. (Naval Postgraduate School, Monterey, Calif. (USA)). Oct 1976. 71p. (NPS--69PS76101). NTIS, PC A04/MF/A01.
Principles governing the performance of the various materials used in contemporary lead--acid storage batteries are reviewed. It is shown how basic developments in materials science and electrochemical technology have led to substantial improvements in this well-established engineering system. The recent use of sophisticated microanalytical techniques to study battery plate behavior has contributed considerable insight into the mechanisms affecting performance under various conditions. These results are reviewed, and their relevance to service behavior is emphasized. The interrelationships between the various component materials of lead--acid systems -- grid alloys, active material compounds, polymeric separators, and conductors and containers -- are considered. (auth)

1998 (AD/A--001526) DATA ACQUISITION TEST REPORT ON OH-58A NICAD BATTERY OPERATION. FINAL TECHNICAL REPORT. Maguire, J.T. (Army Electronics Command, Fort Monmouth, N.J. (USA)). Oct 1974. 78p. (ECOM--4267). NTIS $4.75.
NICKEL-CADMIUM BATTERIES;OPERATION; SIMULATION;TESTING;AIRCRAFT;DATA ACQUISITION; PERFORMANCE TESTING;DATA PROCESSING

1999 (AD/A--001529) ENGINEERING EVALUATION OF THE ZINC--MERCURIC OXIDE BATTERY/NICKEL--CADMIUM BATTERY HYBRID SYSTEM. Wood, D.B. (Army Electronics Command, Fort Monmouth, N.J. (USA)). Nov 1974. 18p. (ECOM--4276). NTIS $3.25.
PRIMARY-SECONDARY HYBRID BATTERIES; PERFORMANCE;NICKEL-CADMIUM BATTERIES; TEMPERATURE DEPENDENCE;MEDIUM TEMPERATURE;RADIO EQUIPMENT POWER SUPPLIES;RELIABILITY;USES

2000 (AD/A--002767) NICKEL/CADMIUM AIRCRAFT BATTERIES: FLOAT CHARGE TEST. Feldman, K.; Lepage, W.A. (Defence Research Establishment, Ottawa, Ontario (Canada)). Oct 1974. 30p. (DREO-R--705). NTIS $3.75.
NICKEL-CADMIUM BATTERIES;AIRCRAFT; RELIABILITY;PERFORMANCE TESTING;HEATING;BATTERY SEPARATORS

2001 (AD/A--002848) ANALYSIS OF ACCELERATED LIFE TEST DATA FOR AEROSPACE NICKEL--CADMIUM CELLS. FINAL REPORT, NOVEMBER 1972--JULY 1974. Roeger, E.A. Jr.; McCallum, J.; Miller, G.H. (Invention Talents, Inc., Columbus, Ohio (USA)). Oct 1974. Contract F33615-73-C-2024. 131p. (AFAPL-TR--74-75). NTIS $5.75.
A process was developed for the accelerated life testing of a particular cell or battery which comprises the comparison and extrapolation of the end of discharge voltages plotted versus the logarithm of the cycle number in combination with prior knowledge about the probable cycles to failure for similar cells or batteries under the same end use conditions. When the slope of the voltage-log cycle line in the test can be made to coincide with similar slopes from prior knowledge, the battery under test will have the same cycle life and failure mechanism as prior cells or batteries. Acceleration of the test results is achieved because a duplication slope for the data obtained during about the first hundred cycles indicates the probable presence of thousands of cycles anticipated by the prior knowledge. (GRA)

2002 (AD/A--006149) PRELIMINARY SAFETY ANALYSIS OF LITHIUM BATTERIES. TECHNICAL REPORT. Hunger, H.F.; Christopulos, J.A. (Army Electronics Command, Fort Monmouth, N.J. (USA)). Feb 1975. 43p. (ECOM--4292). NTIS $3.75.
This report covers the safety aspects of lithium batteries from R and D through manufacture, handling, storage, transport, and operation to disposal. Lithium batteries have advantages over conventional batteries, such as high energy content and low temperature operation capability. The high chemical activity of lithium batteries, however, is the reason for potential hazards, such as explosions, fires, and release to toxic chemicals. Suggested mehods to bring these hazards under control are discussed. Further, safety precautions to be taken by operating personnel and during the fabrication process are outlined. (GRA)

2003 (AD/A--006479) ECONOMIC COMPARISON OF FOUR ELECTRIC POWER SOURCES FOR FORKLIFT TRUCKS. Reavis, D.D. (Army Material Command, Texarkana, Tex. (USA). Intern Training Center). Mar 1974. 82p. (USAMC-ITC--02-08-73-213). NTIS $2.25.
ECONOMICS;COMPARATIVE EVALUATIONS;

MATHEMATICAL MODELS;COST BENEFIT ANALYSIS; ELECTRIC-POWERED VEHICLES;SIMULATION;COMPUTER CALCULATIONS;IRON-NICKEL BATTERIES;LEAD-ACID BATTERIES;LITHIUM-CHLORINE BATTERIES;FUEL CELLS; PRIMARY-SECONDARY HYBRID BATTERIES;ELECTRIC BATTERIES

2004 (AD/A--006571) THE EFFECT OF ADDITIVES ON LITHIUM CYCLING IN PROPYLENE CARBONATE. FINAL TECHNICAL REPORT, 1 JAN 1974-31 JAN 1975. Rauh, R.D.; Brummer, S.B. (Eic, Inc., Newton, Mass. (USA)). Feb 1975. Contract N00014-74-C-0205. 31p. (C--404-1). NTIS $3.75.

Deposition and discharge of lithium on an inert (nickel) substrate in 1M $LiClO_4$/propylene carbonate (PC) has been studied as a function of plating and stripping currents, cycle number, and electrolyte composition. Water (less than 1200 ppm), nitromethane, and $SO_2$ were found to enhance the cycling efficiency, which was relatively low in the dry electrolyte without additives. In all cases, marked deterioration in efficiency was noted after 10 to 20 repeated cycles corrosion was investigated. A mechanism of loss of efficiency during lithium cycling and also on open circuit stand has been formulated. (GRA)

2005 (AD/A--006572) THE EFFECT OF ADDITIVES IN LITHIUM CYCLING IN METHYL ACETATE. FINAL TECHNICAL REPORT, 1 JAN 1974-31 JAN 1975. Rauh, R.D.; Brummer, S.B. (Eic, Inc., Newton, Mass. (USA)). Feb 1975. Contract N00014-74-C-0205. 22p. (C--404-2). NTIS $3.25.

Methyl acetate (MA) was examined as a solvent for use in nonaqueous secondary lithium batteries. The efficiency of cycling lithium on nickel in MA/1M $LiClO_4$ containing less than 10 ppm $H_2O$ was less than 10 percent. Addition of nitromethane (NM), $SO_2$ or small amounts of $H_2O$ improved the efficiency markedly. Compared to propylene carbonate (PC), MA plus $SO_2$ or NM afforded more repeated cycles before failure of the working electrode. Unlike PC, the open circuit corrosion rate of electrodeposited lithium in MA is decreased in the presence of additives. The differences in behavior between PC and MA are attributed to the greater solubility of the MA-lithium reaction products, allowing greater opportunity for buildup of additive-induced conductive films on the metallic deposit. (GRA)

2006 (AD-A--011027) LOW TEMPERATURE RECHARGE OF THE LEAD--ACID SYSTEM. Gardner, C.L.; Rocheleau, F. (Defence Research Establishment, Ottawa, Ontario (Canada)). 1975. 23p. NTIS.

Effects of temp. and $H_2SO_4$ concn. on formation of peroxydisulfuric acid at $PbO_2$ electrode. LEAD-ACID BATTERIES;BATTERY CHARGING; LOW TEMPERATURE;TEMPERATURE DEPENDENCE;SULFURIC ACID;QUANTITY RATIO;CATHODES;PH VALUE; ELECTROLYTES;ORGANIC OXYGEN COMPOUNDS;CHEMICAL REACTION KINETICS

2007 (AD-A--011227) FACILITY SIMULATION MODEL FOR ADVANCED BMD SYSTEMS. VOLUME IVA. POWER MODULE: USER'S MANUAL. FINAL REPORT. Kao, A.; Blackmon, R.; Eng, D.; McDowell, E. (Army Construction Engineering Research Lab., Champaign, Ill. (USA)). Apr 1975. 53p. (CERL-TR-C--28(Vol.4A)). NTIS $4.25.

See also Volume 3C, AD-A--010713, and Volume 4B, AD-A--009748.

This Power Module Volume is divided into a user's manual, a program reference manual, and a program listing. In this user's manual, input formats are outlined for each power system: Diesel engine, gas-turbine engine, turbo-alternator, fuel cells, and batteries. The module calculates the performance characteristics of each system and also selects commercially available power systems from a data base for both diesel and gas-turbine to meet the power output requirements. Five sample problems, one for each power system, illustrate the use of the Power Module. (GRA)

2008 (AD-A--011231) FACILITY SIMULATION MODEL FOR ADVANCED BMD SYSTEMS. VOLUME IVC. POWER MODULE: PROGRAM LISTING. FINAL REPORT. Kao, A.; Blackmon, R.; McDowell, E.; Eng, D. (Army Construction Engineering Research Lab., Champaign, Ill. (USA)). Apr 1975. 45p. (CERL-TR-C--28(Vol.4C)). Availability: Available in microfiche only.

See also Volume 4B, AD-A--009748.

This Power Module volume is divided into a user's manual, a program reference manual, and a program listing. In this program listing, the FORTRAN program of one program in the Power Module is documented. This is Program POWERM. (GRA)

2009 (AD-A--011995) NICKEL/CADMIUM AIRCRAFT BATTERIES: THERMAL CONSIDERATIONS. Feldman, K.; Haines, R.L.; LePage, W.A. (Defence Research Establishment, Ottawa, Ontario (Canada)). Apr 1975. 26p. (DREO-R--718). NTIS $3.75.

Thermal problems in nickel/cadmium aircraft batteries are serious due to effects on battery life and safety of operation. In this study theoretical background of battery heating and cooling was reviewed, and confirmatory experiments were carried out. It was found that, when nickel/cadmium batteries are charged at low rates, cooling takes place, but the reverse is true at high rates. Rapid heating takes place during high rate discharges and also during overcharge if the separator materials permit oxygen to reach the negative plate. Magnitudes involved are illustrated by typical examples. (GRA)

2010 (AD-A--012303) NICKEL HYDROGEN ENERGY STORAGE FOR SATELLITES. SUPPLEMENT TO FINAL REPORT, DEC 1974--FEB 1975. Levy, E. Jr.; Rogers, H.H. (Hughes Aircraft Co., El Segundo, Calif. (USA)). Nov 1974. Contract F33615-73-C-2064. 87p. (SCG--50124). NTIS $4.75.

Supplement to report dated Nov 1974, AD-A--006427..

The purpose of this supplement is to report additional test data on Tyco 50-Ah boilerplate cells, cycle and capacity test results on Eagle-Picher 20-Ah 'prismatic' cells and 50-Ah pineapple-slice design boilerplate cells. Detailed test data are presented and interpreted in this report. An appendix which discusses selection of material for the nickel--hydrogen battery pressure vessel is also provided. (GRA)

2011 (AD-A--013498) CATALYZED REMOVAL OF HYDROGEN FROM ELECTRONIC EQUIPMENT. TECHNICAL REPORT. Gilman, S.; Bramhall, P. (Army Electronics Command, Fort Monmouth, N.J. (USA)). Jul 1975. 34p. (ECOM--4341). NTIS $3.75.

The AN/PRC-77 Radio Set is one example of a semi-sealed electronic equipment in which hydrogen, generated by the battery supply, presents an explosion hazard when in contact with the electronic componentry. This report describes and compares several noble metal catalytic systems which may be used for the purpose of eliminating the hydrogen, through

oxidation with air, in a safe and controlled manner. The report also describes a simple and novel detector utilizing a catalyst which warns of hydrogen entry into a semi-sealed environment. (Author) (GRA)

2012 (AD-A--014337) EVALUATION AND IMPROVEMENT OF A SEALED BATTERY SYSTEM FOR AIRCRAFT. FINAL TECHNICAL REPORT, NOV 1971--JUL 1974. McWhorter, T.A. (Air Force Aero-Propulsion Lab., Wright-Patterson AFB, Ohio (USA)). Apr 1975. 61p. (AFAPL-TR--74-82). NTIS $4.25.

A sealed nickel--cadmium battery with an integral power conditioning package called a Maintenance Free Aircraft Battery was evaluated for compatibility and performance in B-52H, C-135, KC-135 and UH-1F aircraft. Modifications were made to the battery system, as necessary to achieve satisfactory performance. Flight-test results are presented. General compatibility and good performance of the first version of the maintenance-free battery system were experimentally demonstrated. It is recommended that further work be undertaken to establish a reliable, long-term system. (GRA)

2013 (AD-A--014474) RESEARCH AND DEVELOPMENT IN THE GLASS FIBER SODIUM--SULFUR BATTERY. ANNUAL TECHNICAL REPORT. Levine, C.A. (Dow Chemical U.S.A., Walnut Creek, Calif.). 30 Jun 1975. Contract DAHC15-73-C-0254. 25p. NTIS $3.25.

See also report dated 31 Dec 1974, AD-A--008849..

The hollow fiber sodium--sulfur cell has been shown to have outstanding electrochemical characteristics. The major problem is to obtain increased lifetimes and still maintain the good performance. By observing the mode of failure of operating cells the authors have been able to separate those factors that cause shortened lifetime into several categories. They include glass fiber weakening at the tube sheet due to reaction with the tube sheet material, mechanical configurations or damage that puts excess strain on parts of the cell, and degradation of the fiber itself as a function of its electrochemical environment. Small assemblies have been built in which degradation from the sodium side can be isolated from degradation occurring on the sulfide side of the cell. These assemblies allow the authors to run Na--Na cells in which they can change the quality of the sodium anolyte, the current density, and the number of column volumes of sodium charged or discharged per cycle. (GRA)

2014 (AD-A--016132) INVESTIGATION OF CHARGING METHODS FOR NICKEL--CADMIUM BATTERIES. TECHNICAL REPORT. Wagner, O.C.; Williams, D.D. (Army Electronics Command, Fort Monmouth, N.J. (USA)). Sep 1975. 16p. (ECOM--4355). NTIS $3.25.

Sealed nickel--cadmium batteries, each battery consisting of five 4.0-Ah D cells manufactured by General Electric Company, showed little difference in charge acceptance between the pulse and constant current dc charging modes in a temperature range of -20 F to about +100 F. Above +100F maximum charge acceptance is attained at the 2C rate for both charge modes, while at temperatures below +40F the charge rate should be as low as C/10. Charge control by a pressure switch developed by General Research Laboratories proved to be highly practical for the sealed D-type nickel--cadmium batteries employed in this study. Memory, a phenomenon due to the formation of alpha-type nickelic oxide in the nickel cathodes of vented nickel--cadmium batteries, can be erased by occasionally draining the battery to about 0 volt per cell at the C/10 rate. (GRA)

2015 (AD-A--018852) LITHIUM SULFURYL CHLORIDE BATTERY. SEMIANNUAL REPORT, 1 DEC 1974--31 MAY 1975. Nanis, L.; Kapur, V.K.; Huang, M.; Gencer, M.A. (Pennsylvania Univ., Philadelphia (USA). Dept. of Chemical and Biochemical Engineering). Oct 1975. Contract DAAB07-75-C-1676. 33p. NTIS $4.00.

$LiAlCl_4$ in $SO_2Cl_2$ was used as the electrolyte in a battery with a lithium metal anode and a carbon cathode. A preliminary conductivity value for $LiAlCl_4$ (2.5M) in $SO_2Cl_2$ at 25 C was found to be (5 +- 2) $10^{-3}$ $(\Omega\text{-cm})^{-1}$. A simple four-point probe conductivity measurement method has been devised in order to avoid frequency dependent impedance behavior at electrodes and to improve the precision of conductance measurement. Discharge characteristics of the cell $Li/LiAlCl_4$(2.5M)--$SO_2Cl_2$/C were studied. Open circuit voltage of 3.96 V was obtained. Accumulation of reduction products on the carbon cathode decreased the life of the cell. Replacement of the cathode renewed cell activity. (GRA)

2016 (AD-A--019480) STATE OF CHARGE DETERMINATION FOR AEROSPACE BATTERIES. FINAL REPORT, OCT 1973--AUG 1975. Jones, D.C.; DeBerry, D.W.; Clark, W.S. (Radian Corp., Austin, Tex. (USA)). Oct 1975. Contract F33615-74-C-2005. 121p. NTIS $5.50.

High current, short duration pulses were investigated as methods for determining the state-of-charge of nickel--cadmium and zinc--silver oxide batteries. An accurate indicator over the whole state-of-charge range for nickel--cadmium batteries was developed on the basis of a constant voltage discharge pulse and a preconditioning step. The effects of temperature, cycling, and cell variations on test results were determined. The procedure was shown to be able to test cells of unknown background and to detect the presence of weak or defective cells. A constant voltage discharge pulse test was developed to determine if a zinc--silver oxide battery was charged above 80--85% of full capacity. (GRA)

2017 (AD-A--019511) LIGHTWEIGHT LASER DESIGNATOR BATTERY EVALUATION TESTS. FINAL REPORT. Dahlinger, R.J. (Hughes Aircraft Co., Culver City, Calif. (USA). Laser Div.). Feb 1974. Contract DAAB07-72-C-0264. 86p. (HAC-Ref-C--5104; HAC-P--74--181). Availability: Available in microfiche only.

During Phase I, the characteristics required by the Lightweight Laser Designator (LWLD) battery system were defined and compared with the characteristics of all possible candidate systems. Three battery systems were selected for the second phase of the program (cell characterization): lithium-sulphur dioxide, silver-zinc, and nickel-cadmium. During Phase II, the LWLD load was simulated, and the capabilities of the three battery systems were characterized on a single-cell basis. During the single-cell testing, the lithium-sulphur dioxide system was eliminated from further consideration. During Phase III, multi-cell systems of the silver-zinc and nickel-cadmium batteries were tested with the LWLD breadboard as a load. (GRA)

2018 (AD-A--020299) SUPPORT DEVICES FOR SOUNDING ROCKET INSTRUMENTATION SYSTEMS. UNIVERSAL TIME DELAY AND AUTOMATIC TEST SYSTEM. Charron, R.W. (Wentworth Inst., Boston, Mass.

(USA)). 1 Apr 1974. Contract F19628-73-C-0232. 22p. NTIS $3.50.
Two devices have been designed and constructed for use as support equipment for sounding rocket instrumentation systems. The Universal Time Delay was developed to provide supplementary timing functions. The Automatic Test System was developed with the aim of conducting battery charge/discharge tests with a minimum number of man-hours, and with unattended operation for at least 75 hours. (GRA)

2019 (AD-A--023437) SEALED PRIMARY LITHIUM-INORGANIC ELECTROLYTE CELL. QUARTERLY REPORT NO. 7, 1 SEP--30 NOV 1975. Dey, A.N. (Mallory (P.R.) and Co., Inc., Burlington, Mass. (USA). Lab. for Physical Science). Apr 1976. Contract DAAB07-74-C-0109. 39p. NTIS $4.00.
Attention was focussed on the storability of the Li/SOCl2 D cell and the voltage-delay problem after investigating the explosion encountered on high rate discharge, short circuiting and overdischarge. The 45 C storage tests on the Li/SOCl2 hermetic D cells showed that the cells retained a substantial portion of their initial capacity even after 1 year at 45 C, when tested at 25 C at 0.25A. At high rates, there is a significant degradation of the cell capacity. The voltage-delay, though quite severe at high rates at both 25 and -30C, is not present at low rates (0.25A). Furthermore, it appears that partial discharge and intermittent anode pulsing tend to alleviate the voltage-delay problem for low rates of discharge. At high rates the delay is still quite appreciable. An SEM investigation on the Li anode film is being made in an effort to increase our understanding of the mechanism of the voltage-delay. (GRA)

2020 (AD-A--026197) NICKEL/CADMIUM AIRCRAFT BATTERIES: FAILURE PREDICTION IN BATTERY SHOPS BY GASSING RATE MEASUREMENTS. TECHNICAL NOTE. Feldman, K.; Haines, R.L.; Hayashi, R. (Defence Research Establishment, Ottawa, Ontario (Canada)). May 1976. 21p. (DREO-TN--76-12). NTIS (US Sales Only).
One of the serious problems which face a battery shop responsible for maintenance of nickel/cadmium aircraft batteries is to identify cells which would be likely to fail during the next period of service on board the aircraft. At present it seems that nearly all of the catastrophic battery failures which arise on board are due to failure of the separator materials in the cells. In the majority of cases it is likely that gradual deterioration of the separators takes place over a period of time at a rate which in large measure depends on the details of the stress to which the battery is subjected, and in particular to the thermal stress involved. This document discusses two modes of failure due to separator deterioration and how the deterioration may be detected at an early stage by measurement of gas emission. (GRA)

2021 (AD-A--027770) SILVER--ZINC BATTERY CHARACTERISTIC REPORT. Mikkelson, R.P. (General Dynamics/Convair, San Diego, Calif. (USA)). Oct 1966. Contract AF 04(694)-240. 398p. (GDC-BGY66--007). NTIS $10.75.
This test program was undertaken to determine the effect on performance of the manually activated type silver--zinc battery as a result of partial charges, cell shorts, improper filling, contaminated electrolyte, extended wet (activated) stand time, etc., because there had been no previous testing of this nature on this type battery. Two versions of silver--zinc batteries currently in use at General Dynamics Convair on the Atlas missile space launch programs were selected for use in the test program. They were the Yardney 61302 battery (GD-C Part Number 69-06309-1), consisting of 19 PM30 type cells, and the Power Sources 200994 battery (GD-C Part Number 69-06308-1), consisting of 19 cells assembled into three monoblocks. (GRA)

2022 (AD-A--035409) LITHIUM--GRAPHITE SECONDARY BATTERY. TECHNICAL REPORT. Bennion, D.N.; Deshpande, S.L. (California Univ., Los Angeles (USA). School of Engineering and Applied Science). Dec 1976. Contract N00014-75-C-0794. 89p. (UCLA-ENG--76127). NTIS, PC A05/MF A01.
Reactions occurring at the positive and negative electrodes and in the solution phase of cells of the type Li/$LiClO_4$, DMSU/graphite have been studied. Experiments were performed in an H-cell wherein the two electrodes of the cell were isolated in compartments separated by a porous glass frit. Discharge capability of 36 hours at a current density of 2 $mA/cm^2$ have been demonstrated. Discharge potential was about 3.00 V measured versus a lithium wire reference electrode. The effect of operating current on cell performance has been studied. The role of each component of the battery in the charging and discharging reactions has been investigated.

2023 (AD-A--035722) FINAL TECHNICAL REPORT FOR BA 494 /U. Spracklen, D.H. (Eagle-Picher Industries, Inc., Joplin, Mo. (USA). Couples Dept.). 12 Nov 1976. Contract DAHC60-72-C-0053. 30p. NTIS, PC A03/MF A01.
This report covers the testing of two randomly chosen batteries from Lot 22 which have been stored for 54 months at 120F. The failure of some specimens to maintain 14.0 volts after ground power cut-off is discussed in this report. It also contains Discharge Data Sheets, Activation Traces, curves showing X trends for Rise Time and Capacity, and summaries. This report also includes information concerning testing of two batteries stored 9 years, one at room temperature and one at 110F, along with accumulated data from Lot 19. These batteries performed well.

2024 (AD-A--035996) SURVEY OF CONTINUOUS SOURCES OF ELECTRICAL POWER FOR UNDER-ICE PROPULSION OF SMALL SUBMERSIBLES. PART I. CONVENTIONAL SECONDARY BATTERIES. King, T.E.; Moroz, W.J. (Defence Research Establishment, Ottawa, Ontario (Canada)). Feb 1977. 32p. (DREO-R--755). NTIS, PC A03/MF A01.
This report reviews candidate secondary battery systems that can be used for the propulsion of the Canadian Forces SDL-1 submersible. These battery systems are compared in terms of their physical and chemical characteristics and cost. Of the power sources considered, the improved flat-plate lead--acid battery is the most suitable choice to meet the present 300 Ah application. The silver/zinc system with its high energy density is the only one capable of meeting the forecast 800 Ah requirement.

2025 (AD-A--037722) NICKEL/CADMIUM AIRCRAFT BATTERIES: SINGLE SENSOR TEMPERATURE MONITORING. TECHNICAL NOTE. Feldman, K.; Hayashi, R. (Defence Research Establishment, Ottawa, Ontario (Canada)). Mar 1977. 13p. (DREO-TN--77-3). NTIS, PC A02/MF A01.
Abstract in French.

Most of the failures of nickel/cadmium batteries in aircraft are triggered by the development of a short circuit in a single cell in the battery. An experiment was conducted to determine whether the use of a single temperature sensor on an intercell link would be adequate to warn of a short circuit in a cell located elsewhere in the battery. The results indicate that this would not be adequate.

2026 (AD-A--038915) DETECTION OF ELEMENTARY PROCESSES WITHIN POROUS ELECTRODES. INTERIM REPORT. Szpak, S.; Katan, T. (Lockheed Missiles and Space Co., Palo Alto, Calif. (USA). Lockheed Palo Alto Research Lab.). 18 Apr 1977. Contract N00014-73-C-0397. 16p. NTIS PC A02/MF A01.

The interaction of elementary processes within the confines of porous structures is simplified by application of concepts such as penetration depth and a structural unit characteristic of porous electrodes. A systematic approach to the determination of relevant processes and specification of electrode structure is presented. Both experimental and mathematical analogs are used.

2027 (AD-A--039521) NICKEL/CADMIUM AIRCRAFT BATTERIES: BATTERY ALARM UNIT. TECHNICAL NOTE. Feldman, K.; Hayashi, R.M. (Defence Research Establishment, Ottawa, Ontario (Canada)). Apr 1977. 18p. (DREO-TN--77-7). NTIS PC A02/MF A01.

Malfunctions in nickel/cadmium aircraft batteries which may lead to dangerous thermal problems are usually preceded by small atypical decreases in voltage of a single failing cell. Early detection of this decrease can provide time for suitable measures to be taken before other cells are damaged and catastrophic consequences occur. Also detection during battery shop operations can facilitate the screening out of defective cells. The battery alarm unit described in this paper was developed at DREO and is a simple device which monitors the cell voltages by comparing the voltage in one half of the battery with that of the other half. Only three connections to the battery are required. Atypical voltage changes in a single cell, of the order of 50 mV may be detected. The precise sensitivity may be varied by varying resistor values in the input network. The instrument has been found useful in the battery shop both for warning of failing cells in batteries being charged and for attracting attention to cells which show low capacity while being discharged. Presumably the instrument could be equally useful as an early warning device on aircraft. For such applications consideration must be given to questions of procedure, configuration and airworthy mechanical design. Also experience in the field is required on which to base decisions on the optimum sensitivity and whether aircraft and battery shop applications require the same sensitivities. (Author)

2028 (AD-A--041867) LITHIUM--INORGANIC ELECTROLYTE BATTERIES. QUARTERLY PROGRESS REPORT NO. 13, 1 JANUARY--31 MARCH 1977. Driscoll, J.R.; Holleck, G.L.; Gudrais, P.G.; Brummer, S.B. (Eic, Inc., Newton, Mass. (USA)). Jun 1977. Contract DAAB07-74-C-0030. 36p. (C--401). NTIS PC A03/MF A01.

The major area of investigation during this report period has been the voltage delay and depression in $Li/SOCl_2$ cells after storage at 71 C. These are due to films on the Li anode surface which arise from reaction with the electrolyte. The effects of test-cell design and variation in storage procedures have been assessed. Calcium deposited onto the anode decreases the voltage delay. The efficiency of Ca deposition onto Li metal was investigated. An infrared spectrophotometric survey of the $LiAlCl_4/SOCl_2$ electrolyte system was initiated. The question of atmospheric exchange with the storage cells was explored. Argon-filled Al containers were used to store the cells. There was evidence of improvement in the $Li/SOCl_2$ cells with regard to voltage delay up to 300 hours of storage. Infrared spectrophotometry was used to survey the $LiAlCl4/SOCl_2$ electrolyte system. Eastman 246 $SOCl_2$ contains <200 ppm HCl and $SO_2$. After distillation, more $SO_2$, and $SO_2Cl_2$, are detected. Water reacts with $SOCl_2$ to produce $SO_2$ and HCl in direct proportion to the amount added. Solutions of the electrolyte contain HCl, $SO_2$ and hydroxy aluminum compounds. Storage of the electrolyte with Li removes HCl and hydroxy compounds but introduces low levels of other products. Water reacts with the electrolyte solution to produce $SO_2$ and HCl and also hydroxy aluminum components.

2029 (AED-CONF--76-203-006) ELECTROCHEMICAL POWER SOURCES IN OCEAN ENGINEERING. Koethe, H.K. (Varta Batterie A.G., Kelkheim (Germany, F.R.). Forschungs- und Entwicklungszentrum). 1976. 14p. (In German). (CONF-760690--1). Dep. NTIS (US Sales Only) $3.50.

From 3. international conference and exhibition: research-technology-economics (Interocean 76); Duesseldorf, F.R. Germany (15 Jun 1976).

Ocean engineering employs nearly all types of primary and secondary batteries. This wide usage obviously is due to their basic simplicity, compatibility with almost all environmental conditions including high pressure, high reliability, and commercial availability. Fuel cells cannot yet be delivered from stock. However, this lack of availability is not due to poor performance of the prototypes but to the still very limited market. Hence, for the next several years the battery solution will be prevailing, even at high powers. For some missions of long endurance, the combination of batteries with generators using the primary energy of wind, waves, or the sun can be an excellent solution. Almost each battery experiences self-discharge, even when no load is connected to its terminals. Hence, primary reserve electrolyte batteries have been constructed which experience no aging before activation. All primary systems can be operated under sealed conditions. Secondary batteries basically can be divided into vented types and sealed types. Both of them can be operated in the depth of the sea for a prolonged time. Vented batteries for this purpose must be equipped with pressure equalizing systems. Sealed types can be put into pressure hulls, or, if convenient, also be potted into resin. In each of these applications special information for battery operation provided by the supplier. 10 figures, 6 tables.

2030 (ANL--76-8, pp A.66-A.80) BATTERIES FOR ELECTRIC VEHICLES IN WESTERN EUROPE. Lander, G.; Voss, E. (Forschungs- und Entwicklungszentrum der VARTA Batterie AG, Kelkheim/Taunus, Ger.). 1976.

From Battery workshop; Argonne, Illinois, USA (21 Mar 1976).

Proceedings of the symposium and workshop on advanced battery research and design, March 22--24, 1976.

In western Europe a number of electric vehicle projects are currently underway. At

present all vehicles are powered by lead--acid batteries. Lead--acid cells operate at an energy density of 30 to 40 Wh/kg depending on cell design. Cycle life is in the range of 500 to 1600. Maintenance has been reduced to a minimum. The capability of lead--acid batteries to power vehicles for city transport has been demonstrated. 10 figures, 4 tables.

2031 (ANL--76-8, pp B.138-B.151) RECHARGEABLE CALCIUM HIGH-TEMPERATURE CELLS. Preto, S.J.; Ross, L.E.; Martin, A.E.; Roche, M.F. (Argonne National Lab., IL). 1976.
From Battery workshop; Argonne, Illinois, USA (21 Mar 1976).
Proceedings of the symposium and workshop on advanced battery research and design, March 22--24, 1976.
Calcium is an attractive negative electrode material for use in secondary cells because of its great abundance, low equivalent weight, and high reaction energy. In this study, a number of secondary, molten-salt calcium cells having capacities of up to 20 Ah were evaluated in terms of their charge--discharge characteristics. The negative electrodes were compounds of calcium and either aluminum or silicon, the electrolytes were mixtures of calcium chloride and alkali halides, and the positive electrodes were iron sulfide (FeS). These cells generally exhibited high ampere-hour efficiency, good electrode utilization, and a voltage slightly higher than that of comparable lithium cells. 10 figures, 2 tables.

2032 (ANL--76-8, pp B.176-B.188) CHARACTERIZATION OF POROUS LI--AL ALLOY ELECTRODES. Vissers, D.R.; Anderson, K.E. (Argonne National Lab., IL). 1976.
From Battery workshop; Argonne, Illinois, USA (21 Mar 1976).
Proceedings of the symposium and workshop on advanced battery research and design, March 22--24, 1976.
The effects of electrolyte void fraction (0.2, 0.4, and 0.7), electrode thickness (0.3 and 0.6 cm), and the type of current collector on the performance of porous Li--Al electrodes were investigated. The results of these studies, which were conducted at approximately 425°C, were as follows: At moderate current densities (approximately 100 mA/cm$^2$), the lithium utilization (fraction of the theoretical capacity of the Li--Al electrode) decreased markedly as the electrode thickness was increased from 0.32 to 0.64 cm. The capacity densities of the 0.32-cm- and 0.64-cm-thick electrodes were higher with 0.2 volume fraction of the electrolyte than with a higher volume fraction of 0.7. The Li--Al electrode performance was apparently limited by resistive polarization associated with the electrolyte, and with particle-to-particle contact of the Li--Al within the porous structure. The addition of a porous metal current collector greatly improved the performance of the 0.64-cm-thick Li--Al electrode. 13 figures.

2033 (ANL--77-24) ENGINEERING ANALYSIS OF THERMAL PHENOMENA FOR LEAD--ACID BATTERIES DURING RECHARGE PROCESSES. Choi, K.W.; Yao, N.P. (Argonne National Lab., Ill. (USA)). Apr 1977. Contract W-31-109-ENG-38. 41p. Dep. NTIS, PC A04/MF A01.
Transient thermal phenomena in $Pb/PbO_2$ (lead--acid) batteries during charging processes were investigated. Mathematical models were formulated for the studies of heat transfer behavior across the electrode/electrolyte interface within a porous $PbO_2$ electrode during charging, thermal behavior and temperature distribution over a lead--acid battery during different charging processes designed for electric-vehicle propulsion application, and cooling methods for lead--acid batteries during recharge cycles. Numerical solutions show that the heat transfer across the solid electrode and the electrolyte within the porous electrode is so fast that their temperatures may be regarded as the same. The results also show that, in a lead--acid battery designed for electric-vehicle propulsion, the heat generated in the cell during fast charging processes may cause a noticeable rise of temperature in the cell if the heat is not removed properly. The studies of heat-removal processes indicate that incorporation of cooling tubes within the cell cannot effectively remove the heat being released from the cell. However, the heat may be removed effectively by circulation of electrolyte through the battery. Numerical solutions are provided for the engineering evaluation of heat-removal design during battery cycling processes. 25 figures, 4 tables.

2034 (ANL--7663) LITHIUM/SELENIUM SECONDARY CELLS FOR COMPONENTS IN ELECTRIC VEHICULAR-PROPULSION GENERATING SYSTEMS. FIRST SEMIANNUAL TECHNICAL SUMMARY REPORT, MAY 23--NOVEMBER 22, 1969. Cairns, E.J.; Gay, E.C.; Kolba, V.M.; Kyle, M.L.; Tevebaugh, A.D. (Argonne National Lab., Ill. (USA)). Apr 1970. Contract W-31-109-eng-38. 22p. NTIS $3.00.
Up to 2 W/cm$^2$, 10 cycles. METAL-NONMETAL BATTERIES;ELECTRIC-POWERED VEHICLES;DESIGN; FABRICATION;TESTING;LIFETIME;PERFORMANCE; LITHIUM;SELENIUM;HIGH TEMPERATURE

2035 (ANL--7777) LITHIUM/CHALCOGEN SECONDARY CELLS FOR COMPONENTS IN ELECTRIC VEHICULAR-PROPULSION GENERATING SYSTEMS. INTERIM TECHNICAL SUMMARY REPORT NO. 3, MAY 23--NOVEMBER 22, 1970. Cairns, E.J.; Gay, E.C.; Kyle, M.L.; Tevebaugh, A.D.; Trevorrow, L.E. (Argonne National Lab., Ill. (USA)). Mar 1971. Contract W-31-109-ENG-38. 62p. NTIS $3.00.
The immediate goals are the testing of single lithium/chalcogen cells followed by the testing of small (near 1 kW) batteries. Twenty-eight cells were tested during this reporting period. Tests of selenium--thallium and sulfur--thallium mixtures showed promise of achieving the required short-time peak power density and showed no indications of cathode-material transport to the anode. A procedure was developed for fabrication of 7.5-cm diameter paste electrolytes by the molten salt infiltration of disks pressed from pure powdered lithium aluminate. The important property of disks made by this procedure is the low permeability to helium.

2036 (BM-RI--2358) ENDURANCE TESTS OF STORAGE BATTERIES FOR USE IN PERMISSIBLE MINE LOCOMOTIVES. Ilsley, L.C.; Brunot, H.B. (Bureau of Mines, Washington, D.C. (USA)). 1922. 4p. TIC.
Report discusses tests of battery cells manufactured by four companies.

2037 (CONF-691143--, pp 416-433) BATTERY SYSTEMS FOR ELECTRIC CARS. Shair, R.C. Nov 1969.
From 1. international electric vehicle symposium; Phoenix, Arizona, USA (5 Nov 1969).
International electric vehicle symposium.
Brief summaries of present status of batteries with possible vehicular application.

ELECTRIC-POWERED VEHICLES;AUTOMOBILES;ENERGY STORAGE;ELECTRIC BATTERIES;REVIEWS;METAL-NONMETAL BATTERIES;LITHIUM;NICKEL FLUORIDES; NICKEL-CADMIUM BATTERIES

2038 (CONF-711156--, pp 111-116) BATTERIES FOR INNER SPACE. Wilson, J.F. Nov 1971.
From Conference on cosmology, gravitation and applications to particle theory; Bangalore, India (5 Nov 1971).
International electric vehicle symposium.
The batteries under discussion are those employed in a wide variety of applications on the thousands of battery-powered vehicles which operate continuously, deep under the earth's surface in mining applications. There is increased demand for such vehicles. Problems due to poor or virtually non-existent battery and vehicle maintenance are outlined. Among the advantages of electric batteries are safety, flexibility, versatility, and proven capability. One may expect continued innovation in battery-powered equipment. (RWR)

2039 (CONF-711166--, pp 172-186) BATTERIES FOR ELECTRIC VEHICLES. Christianson, C.C. Nov 1971.
From 2. international electric vehicle symposium; Atlantic City, New Jersey, USA (8 Nov 1971).
International electric vehicle symposium.
The requirements and performance characteristics of batteries useful for electric vehicles of the near future are described. Major factors to be considered in selecting a propulsion battery for electric vehicles are energy density, power density, cost, and lifetime. Operational and charging characteristics of the lead--acid battery are discussed in some detail. 6 figures, 4 tables (RWR)

2040 (CONF-711166--, pp 228-246) CHARGING PROCESS. Mas, J.A. Nov 1971.
From 2. international electric vehicle symposium; Atlantic City, New Jersey, USA (8 Nov 1971).
International electric vehicle symposium.
Three fundamental laws were discovered which govern the charging phenomena of all secondary cells. Through the observance and application of these laws it was found possible to charge batteries to the 100 percent level very quickly. For example, 6-Ah lead--acid batteries normally requiring 16 hours were charged in 42 seconds. The discovery of these laws is expected to influence the design concepts of present-day batteries. 7 figures, 3 tables.

2041 (CONF-711166--, pp 247-274) CHARGE ACCEPTANCE CHARACTERISTICS OF THE LEAD--ACID CELL. Rippel, W.E. Nov 1971.
From 2. international electric vehicle symposium; Atlantic City, New Jersey, USA (8 Nov 1971).
International electric vehicle symposium.
The maximum rate at which a lead--acid cell may be charged is limited by one of two factors--either excessive heating or excessive gassing. An experimental study of the charge acceptance behavior of several types of lead--acid cells under gas limiting conditions is described. 16 figures.

2042 (CONF-711166--, pp 540-578) ELECTRIC VEHICLE BATTERIES: USAGE AND ABUSAGE. Boyd, P.G. Nov 1971.
From 2. international electric vehicle symposium; Atlantic City, New Jersey, USA (8 Nov 1971).
International electric vehicle symposium.
Of all the losses experienced by an electric vehicle, the greatest is ''battery wastage,'' the watt-hour per charge which the battery refuses to give out because it is being discharged at a rate in excess of its watt-hour capacity at the optimum 20-h rate. This paper not only points out how to attempt to minimize this ''battery wastage,'' but also argues for better battery charging, discharging, and maintenance. The other losses are considered as well. 5 figures, 2 tables (RWR)

2043 (CONF-741151--, pp vp Paper 30) IMPACTS OF ELECTRIC CAR USE IN LOS ANGELES. Hamilton, W.F. (General Research Corp., Santa Barbara, CA). Sep 1974.
From 2. symposium on low pollution power systems development; Dusseldorf, F.R. Germany (4 Nov 1974).
Second symposium on low pollution power systems development.
Predicted impacts in 1980-2000. ELECTRIC-POWERED VEHICLES;ENVIRONMENTAL EFFECTS; SOCIOLOGY;ECONOMICS;URBAN POPULATIONS; FORECASTING;ELECTRIC BATTERIES;DISTANCE;AIR POLLUTION;ENERGY CONSUMPTION;LEAD-ACID BATTERIES;ZINC-CHLORINE BATTERIES;NICKEL-ZINC BATTERIES;METAL-NONMETAL BATTERIES;COST;FUEL CONSUMPTION;INTERNAL COMBUSTION ENGINES; COMPARATIVE EVALUATIONS;NITROGEN OXIDES;CARBON MONOXIDE;SULFUR DIOXIDE;HYDROCARBONS;PARTICLES; AUTOMOBILES

2044 (CONF-770531--1) ELECTROCHEMISTRY OF LITHIUM/METAL SULFIDE AND CALCIUM/METAL SULFIDE CELLS USING MOLTEN SALT ELECTROLYTES. Steunenberg, R.K.; Roche, M.F. (Argonne National Lab., Ill. (USA)). 1977. Contract W-31-109-ENG-38. 24p. Dep. NTIS, PC A02/MF A01.
From Meeting of the Electrochemical Society; Philadelphia, Pennsylvania, USA (8 May 1977).
The electrochemical properties of lithium/LiCl--KCl/metal sulfide and calcium/LiCl--KCl--$CaCl_2$/metal sulfide cells are described. These cells, which operate at about 700 K, employ intermetallic compounds (rather than elemental lithium or calcium) as their negative electrodes; the positive electrodes are usually iron sulfides, but a variety of other transition metal sulfides have also been tested in lithium cells. The cells with the highest power characteristics are based on the LiAl/$FeS_2$ couple. This couple appears to be limited only by ohmic losses. A statistical model is required, however, to account for the variation in cell polarization with utilization of the electrodes. Results of a variety of metallographic and cyclic voltammetry studies are also described. 8 figures, 3 tables, 47 references.

2045 (CONF-770814--5) COMPOSITION GRADIENT DURING ELECTROLYSIS IN MIXTURES ANALOGOUS TO MOLTEN SALT BATTERY ELECTROLYTES. Heatherly, D.E.; Vallet, C.E. (Oak Ridge National Lab., Tenn. (USA)). 1977. Contract W-7405-ENG-26. 10p. Dep. NTIS, PC A02/MF A01.
From American Chemical Society meeting; Chicago, Illinois, USA (29 Aug 1977).
Molten salt mixtures are attractive electrolytes for more efficient batteries. Li/S batteries with LiCl--KCl mixture as electrolyte have recently been developed. Calculations based on mass transport at electrode--electrolyte interface and in the electrolyte lead to a prediction of a concentration gradient between the electrodes. Experiments in the analogous potassium nitrate--silver nitrate

system that confirm the results of the calculations are reported. The material consists of the descriptions of slides given at a slide presentation. The slides, however, are not included. (RWR)

2046 (EPRI-EM--448-SR) STIBINE FORMATION AND DETECTION IN LEAD ACID BATTERIES. Spindler, W.C. (Electric Power Research Inst., Palo Alto, Calif. (USA)). May 1977. 59p. Dep. NTIS, PC A04/MF A01.
A separate abstract was prepared for each of the four sections of this report. (RWR)

2047 (EPRI-EM--448-SR, pp 1.1-1.9) REMOVAL OF ARSINE AND STIBINE BY LEAD--ACID BATTERY FLASH ARRESTORS. Haynes, D.L.; Fratoni, S.S.; Nanis, L.; Weaver, R.D. May 1977.
Stibine formation and detection in lead acid batteries.
Battery flash arrestors of two representative designs were tested for their efficiency in removing arsine ($AsH_3$) and stibine ($SbH_3$) from a flow-through carrier gas. Arsine and stibine were added to hydrogen to simulate the gas evolving from a lead-acid battery under charging conditions. As determined by simultaneous measurement of gas concentration upstream and downstream of the flash arrestor, $AsH_3$ and $SbH_3$ were not removed. A very small residual accumulation of antimony in a flash arrestor was evident. No comparable arsenic accumulation was detected. Flameless atomic absorption was used for analysis of both Sb and As with a sample time of 3 minutes for a sample flow rate of 40 ml/min. Detection limits under those conditions were 0.6 ppm for $SbH_3$ and 2.4 ppm for $AsH_3$. 1 figure, 2 tables

2048 (EPRI-EM--448-SR, pp 2.1-2.27) STIBINE GENERATION IN THE LEAD--ACID BATTERY. Simon, A.C. May 1977.
Stibine formation and detection in lead acid batteries.
Because very large battery installations (as for load-leveling) are being considered, the possibility for generation of harmful amounts of stibine (and arsine) should be re-examined. Previous work on this problem is reviewed. It is felt that additional experimental work is necessary, although one may hope that the amounts of hydride actually generated will be insignificant. 4 figures, 3 tables, 39 references (RWR)

2049 (EPRI-EM--448-SR, pp 3.1-3.3) GAS LIBERATION IN A LEAD--ACID STORAGE BATTERY. Dasoyan, A.M. May 1977.
Stibine formation and detection in lead acid batteries.
This study compares the gas evolution of storage batteries in which a Pb-Sb alloy is used in preparation of the grid and an alloy to which As was added; it also determines the gas liberation of batteries having the same alloy but varying the conditions of charging, the degree of charging, the temperature of the electrolyte and the environment, and the effects these have on service life. It was found that the gas liberation increased markedly with increase of charging voltage above 28.5 V; in addition, higher temperatures at this voltage increase gas evolution. The presence of As slightly reduced gas evolution. (RWR)

2050 (EPRI-EM--448-SR, pp 4.1-4.12) ELECTROCHEMICAL MECHANISM OF STIBINE FORMATION WHEN CHARGING A LEAD--ACID BATTERY. Aguf, I.A.; Dasoyan, M.A.; Rusin, A.I.; Bamin, A.P. May 1977.
Stibine formation and detection in lead acid batteries.
The electrochemical mechanism of stibine formation on the negative electrode of a lead-acid battery is examined. It is shown that the speed of stibine precipitation during operation of the battery has an extremal dependence on the antimony concentration in the negative filling paste and on the shift in the full charge potential of the negative electrode. 1 figure, 2 tables

2051 (N--66-23780) DEVELOPMENT OF A SEALED LEAD-ACID BATTERY FOR USE IN SPACE. FINAL REPORT. Howard, A.M.; Willihnganz, E.A. (C and D Batteries, Conshohocken, Pa. (USA)). 22 Feb 1966. 53p. (NASA-CR--71293). NTIS $6.00.
LEAD-ACID BATTERIES;SEALS;DESIGN;PERFORMANCE; SPACE VEHICLES;STORAGE LIFE;ENERGY

2052 (N--66-31896) EVALUATION PROGRAM FOR SECONDARY SPACECRAFT CELLS: ACCEPTANCE TEST OF C AND D BATTERIES, 5.0 AMPERE-HOUR SEALED-CALCIUM CELLS. (Naval Ammunition Depot, Crane, Ind. (USA)). 6 Jun 1966. 15p. (NASA-CR--76517). NTIS $3.00.
SPACE VEHICLES;ELECTRIC BATTERIES; PERFORMANCE TESTING;LEAD BASE ALLOYS;SPACECRAFT POWER SUPPLIES;LEAD-ACID BATTERIES

2053 (N--66-35218) RESEARCH AND DEVELOPMENT OF A HIGH CAPACITY, NONAQUEOUS SECONDARY BATTERY. FINAL REPORT, OCTOBER 1964--DECEMBER 1965. Hill, K.R.; Rao, M.L.; Selim, R.G. (Mallory (P.R.) and Co., Inc., Burlington, Mass. (USA)). 14 Feb 1965. 235p. (NASA-CR--54969). NTIS $6.00.
Li/$CuF_2$, Li/AgCl. LITHIUM;ELECTROCHEMISTRY; COPPER FLUORIDES;SILVER CHLORIDES;METAL-NONMETAL BATTERIES;DESIGN;CHEMICAL REACTIONS; ELECTRODES

2054 (N--67-26364) BATTERY WORKSHOP. (National Aeronautics and Space Administration, Washington, D.C. (USA)). Oct 1966. 426p. NTIS $6.00.
LEAD-ACID BATTERIES;NICKEL-CADMIUM BATTERIES; SILVER-CADMIUM BATTERIES;SILVER-ZINC BATTERIES; NONDESTRUCTIVE TESTING;USES

2055 (N--69-37830) EVALUATION PROGRAM FOR SECONDARY SPACECRAFT CELLS. ACCEPTANCE TEST OF GENERAL ELECTRIC COMPANY 12 AMPERE-HOUR AUXILIARY ELECTRODE NICKEL--CADMIUM CELLS. Christy, D.E. (Naval Ammunition Depot, Crane, Ind. (USA)). 15 Jul 1969. 29p. (NASA-CR--108530). NTIS, PC A07/MF A01.
PERFORMANCE TESTING;NICKEL-CADMIUM BATTERIES; LEAKS;PHENOLPHTHALEIN;SEALS;ELECTRIC CONDUCTIVITY;ELECTRODES;SPACECRAFT POWER SUPPLIES

2056 (N--69-38275) EVALUATION PROGRAM FOR SECONDARY SPACECRAFT CELLS. EVALUATION OF STORAGE METHODS, OPEN CIRCUIT VERSUS CONTINUOUS TRICKLE CHARGE, SONOTONE 3.5 AMPERE-HOUR SEALED NICKEL--CADMIUM SECONDARY SPACECRAFT CELLS. Christy, D.E. (Naval Ammunition Depot, Crane, Ind. (USA)). 6 Feb 1969. 27p. (NASA-CR--106003). NTIS, PC A07/MF A01.
STORAGE;NICKEL-CADMIUM BATTERIES;BATTERY CHARGING;SPACECRAFT POWER SUPPLIES

2057 (N--69-39418) RESEARCH INTO

FUNDAMENTAL PHENOMENA ASSOCIATED WITH SPACECRAFT ELECTROCHEMICAL DEVICES: CALORIMETRY OF NICKEL--CADMIUM CELLS. PROGRESS REPORT, 1 JULY--30 SEPTEMBER 1968. Foley, R.T.; Mitchell, G.D. (American Univ., Washington, D.C.). 30 Sep 1968. 41p. (NASA-CR--106201). NTIS, PC A07/MF A01.
6- and 20-Ah cells. CALORIMETRY;NICKEL-CADMIUM BATTERIES;BATTERY CHARGING;OPERATION; COMPUTER CODES;ELECTROCHEMISTRY;PERFORMANCE; TESTING;TEMPERATURE GRADIENTS;THERMODYNAMIC PROPERTIES;HEAT TRANSFER;SPACE VEHICLES

2058 (N--69-40947) RESEARCH INTO FUNDAMENTAL PHENOMENA ASSOCIATED WITH SPACECRAFT--ELECTROCHEMICAL DEVICES AND CALORIMETRY OF NICKEL--CADMIUM CELLS. PROGRESS REPORT, 1 OCTOBER 1968--31 AUGUST 1969. Foley, R.T.; Mitchell, G.D. (American Univ., Washington, D.C.). 31 Aug 1969. 23p. (NASA-CR--106392). NTIS, PC A07/MF A01.
ELECTROCHEMISTRY;EDUCATION;THERMODYNAMIC PROPERTIES;CALORIMETRY;NICKEL-CADMIUM BATTERIES; HEAT TRANSFER;ACCURACY;SPACE VEHICLES; FABRICATION;FLOW RATE

2059 (N--70-30138) SPACE-RATED NICKEL/ CADMIUM BATTERIES AND THEIR CHARGE CONTROL. Seibert, G. (European Space Research and Technology Centre, Noordwijk (Netherlands)). May 1969. 48p. (ESRO-TM--138/ESTEC/). NTIS, PC A02/MF A01.
NICKEL-CADMIUM BATTERIES;BATTERY CHARGING; CONTROL;PERFORMANCE TESTING;SPACECRAFT POWER SUPPLIES;ELECTROCHEMISTRY

2060 (N--70-38614) TESTING OF SILVER CADMIUM CELLS. FINAL REPORT. Read, M.D. (General Electric Co., Philadelphia, Pa. (USA). Missile and Space Div.). 1 May 1970. 47p. (NASA-CR--72719). NTIS, PC A03/A01.
A test program was carried out to determine the life cycling capability of silver/cadmium cells constructed with a new type of inorganic separator. The analyses revealed that the most probable cause of failure for these cells was silver migration and separator permeability.

2061 (N--70-39718) STUDIES IN FUNDAMENTAL CHEMISTRY OF FUEL CELL REACTIONS. QUARTERLY REPORT, 1 JANUARY--31 MARCH 1970. Bockris, J.O. (Pennsylvania Univ., Philadelphia (USA). Electrochemistry Lab.). 31 Mar 1970. Contract NGR-39-010-002. 30p. (NASA-CR--113599). NTIS $3.00.
ZINC-AIR BATTERIES;CHEMICAL REACTIONS; *RHODIZONIC ACID;GRAPHITE;EFFICIENCY;PERFORMANCE* TESTING;OXYGEN;REDUCTION;ADSORPTION;DENDRITES; CRYSTAL GROWTH;SILVER-ZINC BATTERIES;PLATINUM; ELECTROCHEMISTRY

2062 (N--70-41390) STUDIES IN FUNDAMENTAL CHEMISTRY OF FUEL CELL REACTIONS. QUARTERLY REPORT, 1 APRIL--30 JUNE 1970. Bockris, J.O. (Pennsylvania Univ., Philadelphia (USA). Electrochemistry Lab.). Jun 1970. Contract NGR-39-010-002. 19p. (NASA-CR--113916; QR--6). NTIS $3.00.
ELECTROCHEMISTRY;CHEMICAL REACTIONS; ACTIVATION ENERGY;MATHEMATICAL MODELS;DENDRITES; CRYSTAL GROWTH;ZINC-AIR BATTERIES

2063 (N--71-13426) EVALUATION PROGRAM FOR SECONDARY SPACECRAFT CELLS. EVALUATION OF STORAGE METHODS, OPEN CIRCUIT VERSUS CONTINUOUS TRICKLE CHARGE, SONOTONE 3.5 AMPERE-HOUR SEALED NICKEL--CADMIUM SECONDARY SPACECRAFT CELLS. Thomas, R.E. (Naval Ammunition Depot, Crane, Ind. (USA)). 5 Nov 1969. 35p. (NASA-CR--115787; QE/C--70-88). NTIS, PC A03/MF A01.
SPACECRAFT POWER SUPPLIES;STORAGE;SEALS; NICKEL-CADMIUM BATTERIES;BATTERY CHARGING

2064 (N--71-26289) STUDIES IN FUNDAMENTAL CHEMISTRY OF FUEL CELL REACTIONS. QUARTERLY REPORT, 1 JULY--30 SEPTEMBER 1970. Bockris, J.O. (Pennsylvania Univ., Philadelphia (USA). Electrochemistry Lab.). 30 Sep 1970. Contract NGR-39-010-002. 35p. (NASA-CR--118652; QR--7). NTIS $3.00.
SILVER-ZINC BATTERIES;ELECTROCHEMISTRY; CHEMICAL REACTIONS;ACTIVATION ENERGY;OXYGEN; TRACER TECHNIQUES;RHODIZONIC ACID;GRAPHITE; ELECTRODES;RESEARCH PROGRAMS

2065 (N--71-30827) STUDIES IN FUNDAMENTAL CHEMISTRY OF FUEL CELL REACTIONS. QUARTERLY REPORT, 1 JANUARY--31 MARCH 1971. Bockris, J.OM. (Pennsylvania Univ., Philadelphia (USA). Electrochemistry Lab.). 31 Mar 1971. Contract NGR-39-010-002. 33p. (NASA-CR--119247; QR--9). NTIS $3.00.
ELECTROCHEMISTRY;RESEARCH PROGRAMS;SILVER-ZINC BATTERIES;CRYSTAL GROWTH;DENDRITES; ELECTRODES;CHEMICAL REACTIONS

2066 (N--74-10078) FABRICATION AND TESTING OF NEGATIVE-LIMITED SEALED NICKEL--CADMIUM CELLS. QUARTERLY REPORT, 1 JUL-30 SEP 1973. Luksha, E.; Kohl, K.C. (Gould, Inc., Mendota Heights, Minn. (USA)). 10 Oct 1973. Contract NAS7-100; JPL-953680. 15p. (NASA-CR--135981; Rept--732-015-1). NTIS $3.00.
3 and 20 Ah. NICKEL-CADMIUM BATTERIES; FABRICATION;TESTING;DESIGN;DIMENSIONS; ELECTRODES

2067 (N--74-12741) ACCELERATED TEST PLAN FOR NICKEL--CADMIUM SPACECRAFT BATTERIES. Hennigan, T.J. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center). Oct 1973. 52p. (NASA-TM-X--70524; X--761-73-183). NTIS $4.75.
NICKEL-CADMIUM BATTERIES;SPACE VEHICLES; TESTING

2068 (N--74-12745) LITHIUM BATTERY WITH INORGANIC ELECTROLYTE. FINAL REPORT, 1 DEC 1971--31 MAY 1973. Auborn, J.J.; French, K.W.; Heller, A.; Lieberman, S. (GTE Labs., Inc., Waltham, Mass. (USA)). Sep 1973. Contract DAAB-07-72-C-0060. 62p. (AD--767624; TR--73-845-1; *ECOM--0060-F-72*). NTIS.
Li/Cl cells with halogen/Pt halogen/ graphite, nonmetallic and metallic cathode systems. METAL-GAS BATTERIES;METAL-METAL BATTERIES;METAL-NONMETAL BATTERIES;OPERATION; PERFORMANCE

2069 (N--74-13761) EVALUATION PROGRAM FOR SECONDARY SPACECRAFT CELLS: INITIAL EVALUATION TESTS OF GULTON INDUSTRIES, INCORPORATED, 20.0 AMPERE-HOUR NICKEL--CADMIUM SPACECRAFT CELLS WITH AUXILIARY ELECTRODES. Harkness, J.D. (Naval Ammunition Depot, Crane, Ind. (USA)). 4 Jan 1974. 23p. (NASA-CR--136318; QEEL/C--74-2). NTIS $3.25.
SPACE VEHICLES;NICKEL-CADMIUM BATTERIES; TESTING

2070 (N--74-13762) EVALUATION PROGRAM FOR SECONDARY SPACECRAFT CELLS: SYNCHRONOUS ORBIT TESTING OF GENERAL ELECTRIC COMPANY 6.0 AMPERE-HOUR SEALED NICKEL--CADMIUM CELLS. Christy,

D.E. (Naval Ammunition Depot, Crane, Ind. (USA)). 15 Oct 1973. 47p. (NASA-CR--136317; QEEL/C--73-302). NTIS $4.50.
NICKEL-CADMIUM BATTERIES;TESTING;PERFORMANCE; SATELLITES;TEMPERATURE DEPENDENCE;ELECTRIC POTENTIAL

2071 (N--74-13763) EVALUATION PROGRAM FOR SECONDARY SPACECRAFT CELLS. INITIAL EVALUATION TESTS OF EAGLE-PICHER INDUSTRIES, INCORPORATED, 3.0 AMPERE-HOUR NICKEL--CADMIUM SPACECRAFT CELLS. Harkness, J.D. (Naval Ammunition Depot, Crane, Ind. (USA)). 29 Oct 1973. 23p. (NASA-CR--136253; QEEL/C--73-380). NTIS $3.25.
NICKEL-CADMIUM BATTERIES;PERFORMANCE TESTING; SPACE VEHICLES

2072 (N--74-15773) STUDY OF NICKEL--CADMIUM BATTERIES FOR USE IN APPLICATIONS SATELLITES. PHASE 1. Font, S. (Societe des Accumulateurs Fixes et de Traction, Romainville (France). Dept. Accumulateurs Alcalins). Nov 1972. Contract ESTEC-1358/71-SL. 66p. (In French). (DT/SAS--298/72-SF/JM; Rept--01; ESRO-CR(P)--323). NTIS $5.50.
SATELLITES;NICKEL-CADMIUM BATTERIES; PERFORMANCE

2073 (N--74-16757, pp 123-136) ENERGY STORAGE USING HIGH-PRESSURE ELECTROLYSIS AND METHODS FOR RECONVERSION. Hughes, W.L. (Oklahoma State Univ., Stillwater). Dec 1973.
From Proceedings on wind energy conversion systems; Washington, District of Columbia, USA (11 Jun 1973).
Wind energy conversion systems.
WIND TURBINES;ENERGY STORAGE;ELECTROLYSIS; ELECTROLYTIC CELLS;SPECIFICATIONS;PERFORMANCE

2074 (N--74-16757, pp 146-152) BATTERIES FOR STORAGE OF WIND-GENERATED ENERGY. Schwartz, H.J. (Lewis Research Center, Cleveland). Dec 1973.
From Proceedings on wind energy conversion systems; Washington, District of Columbia, USA (11 Jun 1973).
Wind energy conversion systems.
WIND TURBINES;ENERGY STORAGE;ELECTRIC BATTERIES;PERFORMANCE;COMPARATIVE EVALUATIONS; COST

2075 (N--74-16784, pp 146-51) BATTERIES FOR STORAGE OF WIND-GENERATED ENERGY. Schwartz, H.J. Dec 1973.
See N--74-16757.
Wind energy conversion systems.
Alkali metal batteries. LEAD-ACID BATTERIES; ZINC-CHLORINE BATTERIES;ELECTRIC BATTERIES; ECONOMICS;COMPARATIVE EVALUATIONS;WIND POWER; ENERGY STORAGE

2076 (N--74-16812) STUDY OF NICKEL--CADMIUM BATTERIES FOR USE IN APPLICATIONS SATELLITES, PHASE 2. EVALUATION OF CHARGE STORAGE OF CHARGED NI--CD VO 23S BATTERIES. Font, S. (Societe des Accumulateurs Fixes et de Traction, Romainville (France). Dept. Accumlateurs Alcalins). Dec 1972. Contract ESTEC-1357/71-SL. 12p. (In French). (DT/SAS--533/72-SF/JM; Rept--02; ESRO-CR(P)--324). NTIS $4.00.
NICKEL-CADMIUM BATTERIES;SATELLITES; TEMPERATURE DEPENDENCE;PERFORMANCE TESTING

2077 (N--74-16813) STUDY OF NICKEL--CADMIUM BATTERIES FOR USE IN APPLICATIONS SATELLITES, PHASE 2. EVALUATION OF ELECTRICAL IMPEDANCE AS A FUNCTION OF THE FREQUENCY AT VARIOUS TEMPERATURES AND CHARGE STATES OF NI--CD VO 23S BATTERIES. Font, S. (Societe des Accumulateurs Fixes et de Traction, Romainville (France). Dept. Accumulateurs Alcalins). Feb 1973. Contract ESTEC-1358/72-SL. 30p. (In French). (DT/SAS--176/73-SF/JM; Rept--04; ESRO-CR(P)--326). NTIS $4.50.
NICKEL-CADMIUM BATTERIES;SATELLITES; FREQUENCY DEPENDENCE;IMPEDANCE;TEMPERATURE DEPENDENCE;HZ RANGE;KHZ RANGE

2078 (N--74-16814) STUDY OF NICKEL--CADMIUM BATTERIES FOR USE IN APPLICATIONS SATELLITES, PHASE 3. Font, S. (Societe des Accumulateurs Fixes et de Traction, Romainville (France). Dept. Accumulateurs Alcalins). Jul 1973. Contract ESTEC-1358/71-SL. 43p. (DT/SAS--543/73-SF/JM; Rept--08; ESRO-CR(P)--330). NTIS $5.25.
NICKEL-CADMIUM BATTERIES;SATELLITES; TEMPERATURE DEPENDENCE;OPERATION;BATTERY CHARGING;LIFETIME

2079 (N--74-17803) EVALUATION PROGRAM FOR SECONDARY SPACECRAFT CELLS: INITIAL EVALUATION TESTS OF 20.0 AMPERE-HOUR NICKEL--CADMIUM SPACECRAFT CELLS MANUFACTURED BY GULTON INDUSTRIES, INCORPORATED. Harkness, J.D. (Naval Ammunition Depot, Crane, Ind. (USA)). 3 Dec 1973. 22p. (NASA-CR--137203; AD--771843; QEEL/C--73-459). NTIS $4.25.
SPACE VEHICLES;NICKEL-CADMIUM BATTERIES; TESTING;PERFORMANCE

2080 (N--74-19703) EVALUATION PROGRAM FOR SECONDARY SPACECRAFT CELLS: INITIAL EVALUATON TESTS OF GENERAL ELECTRIC COMPANY 6.0 AMPERE HOUR NICKEL--CADMIUM SPACECRAFT CELLS WITH AUXILIARY ELECTRODES FOR THE ATMOSPHERIC EXPLORER SATELLITE C AND D. Harkness, J.D. (Naval Ammunition Depot, Crane, Ind. (USA)). 2 Jan 1974. 25p. (NASA-CR--138985; QEEL/C--74-1). NTIS $4.25.
EXPLORER SATELLITES;NICKEL-CADMIUM BATTERIES; ELECTRODES;PERFORMANCE TESTING

2081 (N--74-26502) EVALUATION PROGRAM FOR SECONDARY SPACECRAFT CELLS: CYCLE LIFE TEST. ANNUAL REPORT. Christy, D.E.; Harkness, J.D. (Naval Ammunition Depot, Crane, Ind. (USA)). 15 Feb 1974. 261p. (NASA-CR--138604; QEEL/C--74-34; AR--10). NTIS $16.25.
SPACE VEHICLES;PERFORMANCE TESTING; TEMPERATURE DEPENDENCE;LIFETIME;SATELLITES; ELECTRIC BATTERIES

2082 (N--74-31530) EVALUATION PROGRAM FOR SECONDARY SPACECRAFT CELLS. INITIAL EVALUATION TESTS OF GENERAL ELECTRIC COMPANY STANDARD AND TEFLONATED NEGATIVE ELECTRODE 20.0 AMPERE-HOUR, NICKEL--CADMIUM SPACECRAFT CELLS WITH AUXILIARY ELECTRODES. (Naval Ammunition Depot, Crane, Ind. (USA)). 1 Jul 1974. 28p. (NASA-CR--139654; WQEC/C--74-337). NTIS $4.50.
PERFORMANCE TESTING;SPACE VEHICLES;NICKEL-CADMIUM BATTERIES;ELECTRIC POTENTIAL

2083 (N--75-12278) DEVELOPMENT OF A BATTERY STATUS MONITOR. FINAL REPORT. Zimmerman, R.I. (Chrysler Corp., New Orleans, La. (USA). Space Div.). Jul 1974. Contract NAS9-13654. 46p. (NASA-CR--140362). NTIS $3.75.
ELECTRIC BATTERIES;PERFORMANCE;OPERATION

2084 (N--75-17788) EVALUATION PROGRAM FOR SECONDARY SPACECRAFT CELLS. INITIAL EVALUATION TESTS OF GULTON INDUSTRIES, INCORPORATED 6.0 AMPERE-HOUR NICKEL--CADMIUM SPACECRAFT CELLS FOR THE SAN MARCO SPACECRAFT. Harkness, J.D. (Naval Ammunition Depot, Crane, Ind. (USA)). 3 Jan 1975. 19p. (NASA-CR--141232). NTIS.
ELECTRIC BATTERIES;TESTING

2085 (N--75-17789) EVALUATION PROGRAM FOR SECONDARY SPACECRAFT CELLS: INITIAL EVALUATION TESTS OF EAGLE-PICHER INDUSTRIES, INCORPORATED 6.0 AMPERE-HOUR, NICKEL--CADMIUM SPACECRAFT CELLS FOR SEPARATOR MATERIAL EVALUATION. Harkness, J.D. (Naval Ammunition Depot, Crane, Ind. (USA)). 17 Jan 1975. 21p. (NASA-CR--141231). NTIS $3.25.
ENERGY STORAGE;ELECTRIC BATTERIES;BATTERY SEPARATORS;COMPARATIVE EVALUATIONS

2086 (N--75-24866) DETERMINATION OF HYDROXIDE AND CARBONATE CONTENTS OF ALKALINE ELECTROLYTES CONTAINING ZINC. Otterson, D.A. (National Aeronautics and Space Administration, Cleveland, Ohio (USA). Lewis Research Center). Jun 1975. 12p. (NASA-TN-D--8007; E--8304). NTIS $3.25.
A method to prevent zinc interference with the titration of OH- and CO3-2 ions in alkaline electrolytes with standard acid is presented. The Ba-EDTA complex was tested and shown to prevent zinc interference with acid-base titrations without introducing other types of interference. Theoretical considerations indicate that this method can be used to prevent interference by other metals. (auth)

2087 (N--75-25290) GENERAL ELECTRIC 20-AMPERE HOUR NICKEL--CADMIUM BATTERY. INTERIM TEST REPORT. Kirsch, W.W. (Sperry Rand Corp., Great Neck, N.Y. (USA)). 30 May 1974. Contract NAS8-21812. 22p. (NASA-CR--120748; REPT--40M22410). NTIS $3.25.
The interaction, effect, and controllability of the performance parameters of the General Electric 20-ampere-hour, 24-cell nickel--cadmium battery are investigated. The battery was cycled under simulated orbit conditions. The acquired data were analyzed and evaluated in terms of battery parameters and performance characteristics. Conclusions and tests results are presented along with recommendations for further study. (GRA)

2088 (N--75-27566) A STUDY OF SHORT TEST AND CHARGE RETENTION TEST METHODS FOR NICKEL-CADMIUM SPACECRAFT CELLS. FINAL REPORT. Scott, W.R. (TRW Systems Group, Redondo Beach, Calif. (USA)). Apr 1975. Contracts NAS7-100;JPL-953649. 193p. (NASA-CR--143189; TRW--24118-6003-RU-00). NTIS $7.00.
Methods for testing nickel-cadmium cells for internal shorts and charge retention were studied. Included were (a) open circuit voltage decay after a brief charge, (b) open circuit voltage recovery after shorting, and (c) open circuit voltage decay and capacity loss after a full charge. The investigation included consideration of the effects of prior history, of conditioning cells prior to testing, and of various test method variables on the results of the tests. Sensitivity of the tests was calibrated in terms of equivalent external resistance. The results were correlated. It was shown that a large number of variables may affect the results of these tests. It is concluded that the voltage decay after a brief charge and the voltage recovery methods are more sensitive than the charged stand method, and can detect an internal short equivalent to a resistance of about (10,000/C)ohms where C' is the numerical value of the capacity of the cell in ampere hours.

2089 (N--75-30652) EVALUATION PROGRAM FOR SECONDARY SPACECRAFT CELLS: INITIAL EVALUATION TESTS OF GENERAL ELECTRIC COMPANY 6.0 AMPERE-HOUR NICKEL--CADMIUM SPACECRAFT CELLS FOR THE IMPROVED TIROS OPERATIONAL SATELLITE (ITOS). Harkness, J.D. (Naval Weapons Support Center, Crane, Ind. (USA)). 1 Jul 1975. 14p. (NASA-CR--144667; WQEC/C--75-164). NTIS $3.25.
Quality control measures for Ni--Cd spacecraft cells were analyzed. Cells were examined for electrolyte leakage, internal shorts, low capacity, or inability of any cell to recover its open circuit voltage above 1.50 volts during the internal short test. Test results are given in tabular form. (auth)

2090 (N--75-32588) THE ELECTRICAL PERFORMANCE OF AG/ZN BATTERIES FOR THE VENUS MULTI-PROBE MISSION. Palandati, C. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center). Jun 1975. 45p. (NASA-TM-X--72876; X--711-75-197). NTIS $4.00.
An evaluation of 5-Ah and 21-Ah silver--zinc batteries was made to determine their suitability to meet the energy storage requirements of the bus vehicle, 3 small probes, and large probe for the Venus multi-probe mission. The evaluation included a 4-Ah battery for the small probe, a 21-Ah battery for the large probe, one battery of each size for the bus vehicle power, a periodic cycling test on each size battery, and a wet stand test of charged and discharged cells of both cell designs. The study on the probe batteries and bus vehicle batteries included both electrical and thermal simulation for the entire mission. The effects on silver migration and zinc penetration of the cellophane separators caused by the various test parameters were determined by visual and x-ray fluorescence analysis. The 5-Ah batteries supported the power requirements for the bus vehicle and small probe. The 21-Ah large probe battery supplied the required mission power. Both probe batteries delivered in excess of 132 percent of rated capacity at the completion of the mission simulation. (auth)

2091 (N--75-33493) FABRICATION AND TESTING OF NEGATIVE-LIMITED SEALED NICKEL--CADMIUM CELLS. FINAL REPORT, 1 JUL 1974--28 FEB 1975. Gordy, D.J. (Gould, Inc., Mendota Heights, Minn. (USA)). 31 Mar 1975. Contracts NAS7-100;JPL-953680. 68p. (NASA-CR--143628; REPT--752-015). NTIS $4.50.
A number of 20-Ah and 3-Ah negative-limited nickel--cadmium cells were fabricated and assembled in hermetically sealed stainless steel containers. The cells exhibit a large voltage rise signal, in excess of 250 mA, at the end of each charge period. They also exhibit lower self-discharge rates than conventional sealed nickel--cadmium cells and do not require overcharge. The cells are capable of operating at charge and discharge rates up to 5C and can deliver at least 1000 cycles on a 30-minute regime at 25% DOD. A small amount of gassing occurs, but is not deemed critical or detrimental in view of the facts that operating pressures are in the range of 7 to 20 psig and the cells are operated in the flooded condition and so contain little internal void volume. The cells were found to exhibit somewhat higher capacity loss rates

during cycling than conventional sealed nickel--cadmium batteries. (auth)

2092 (N--76-11560) TEST ON SEALED NI/CD CELLS FOR SATELLITE USE. Hallgren, B.; Samsioe, P.E. (Foersvarets Forskningsanstalt, Stockholm (Sweden)). Aug 1975. Contract ESTEC-887/69-HP. 181p. (ESA-CR--576). NTIS $7.50.

The performance of 6 Ah Ni/Cd cells manufactured for space application was evaluated. Capacity and charge/discharge voltages were determined as a function of operating temperature, charge current, and discharge current. A short study of charge efficiency and overcharge at constant voltage completed the characterization of the cell. The lifetime of the cell was studied in low orbit-like cycling over a wide range of operating conditions. (GRA)

2093 (N--76-20642) SERVICE LIFE OF AG--CD BATTERIES ON GEOSTATIONARY ORBIT DETERMINATION DE LA DUREE DE VIE DES ACCUMULATERUS ARGENT-CADMIUM EN ORBITE GEOSTATIONNAIRE. FINAL REPORT. Goualard, J. Oct 1975. Contract ESTEC-1816/72-HP. 125p. (DT/SAS--561/74-JG/JM; ESA-CR(P)--783). NTIS $5.50.

Types Ag--Cd 5S SAFT and YS 10S YARDNEY batteries were examined and cycled in normal and accelerated tests. Results for cycling tests during a 2-year period show that the service life must be expressed in number of days instead of cycles, and the previous storage period should be taken into account. The maximum life of the Ag--Cd 5S battery varies from 400 to 900 days for discharge depths from 66 to 30%. The maximum operating temperature is 0 C. The most favorable storage conditions are 0 C temperature and open circuit. A detailed failure analysis was carried out. (GRA)

2094 (N--76-20643) EVALUATION OF A NICKEL--HYDROGEN BATTERY FOR SPACE APPLICATION. FINAL REPORT. Billard, J.M.; Dupont, D. Oct 1975. Contract ESTEC-2345/74-HP. 106p. (DT/SAS--674/75-JMB/JM; ESA-CR(P)--784). NTIS $5.50.

Results of electrical space qualification tests of a nickel--hydrogen battery type HR 23S are presented. The results obtained are similar to those obtained for the nickel--cadmium battery type VO 23S, except that the voltage level and the charge conservation characteristics vary significantly. The electrical and thermal characteristics permit predictions of the following optimal applications: charge coefficient in the order of 1.3 to 1.4 at 20 C; charge current density higher than C/10 at 20 C; discharge current density from C/10 to C/3 at 20 C; maximum discharge temperature: 0 C; storage temperature: -20 C. (GRA)

2095 (N--76-24703) CADMIUM MIGRATION IN AEROSPACE NICKEL CADMIUM CELLS. Mcdermott, P.P. (Coppin State Coll., Baltimore, Md. (USA)). Mar 1976. 32p. (NASA-CR--144753). NTIS $4.00.

The effects of temperature, the nature of separator material, charge and discharge, carbonate contamination, and the mode of storage are studied with respect to the migration of active material from the negative toward the positive plate. A theoretical model is proposed which takes into account the solubility of cadmium in various concentrations of hydroxide and carbonate at different temperatures, the generation of the cadmiate ion, $Cd(OH)_3^-$, during discharge, the migration of the cadmiate ion and particulate $Cd(OH)_2$ due to electrophoretic effects and the movement of electrolyte in and out of the negative plate and, finally, the recrystallization of cadmiate ion in the separator as $Cd(OH)_2$. Application of the theoretical model to observations of cadmium migration in cycled cells is also discussed.

2096 (N--76-26687) CYCLE LIFE TEST. EVALUATION PROGRAM FOR SECONDARY SPACECRAFT CELLS. ANNUAL REPORT. Harkness, J.D. (Naval Weapons Support Center, Crane, Ind. (USA)). 11 Feb 1976. Contract S-53742AG. 278p. (NASA-CR--148208; WQEC/C--76-5). NTIS $9.25.

Considerable research is being done to find more efficient and reliable means of starting electrical energy for orbiting satellites. Rechargeable cells offer one such means. A test program is described which has been established in order to further the evaluation of certain types of cells and to obtain performance and failure data as an aid to their continued improvement. The purpose of the program is to determine the cycling performance capabilities of packs of cells under different load and temperature conditions. The various kinds of cells tested were nickel--cadmium, silver--cadmium, and silver--zinc sealed cells. A summary of the results of the life cycling program is given in this report. (auth)

2097 (N--76-26688) ACCELERATED TEST PROGRAM FOR SEALED NICKEL--CADMIUM SPACECRAFT BATTERIES/CELLS. INTERIM REPORT. Goodman, L.A. (Naval Weapons Support Center, Crane, Ind. (USA)). 13 Feb 1976. 78p. (NASA-CR--148209; WQEC/C--76-8). NTIS $5.00.

The feasibility was examined of inducing an accelerated test on sealed nickel-cadmium batteries or cells as a tool for spacecraft projects and battery users to determine the prediction of life capability, a method of evaluating the effect of design and component changes in cells, and a means of reducing time and cost of cell testing. (auth)

2098 (N--76-26693) EVALUATION PROGRAM FOR SECONDARY SPACECRAFT CELLS: INITIAL EVALUATION TESTS OF GENERAL ELECTRIC COMPANY 12.0 AMPERE-HOUR NICKEL--CADMIUM SPACECRAFT CELLS FOR THE INTERNATIONAL ULTRAVIOLET EXPLORER. Harkness, J.D. (Naval Weapons Support Center, Crane, Ind. (USA)). 15 Mar 1976. 17p. (NASA-CR--148190; WQEC/C--76-89). NTIS $3.50.

An evaluation test program was conducted to insure that all cells put into the life cycle program are of high quality by the screening of cells found to have electrolyte leakage, internal shorts, low capacity, or inability of any cell to recover its open-circuit voltage above 1.150 volts during the internal short test. The 20 cells were manufactured for the National Aeronautics and Space Administration, Goddard Space Flight Center (GSFC). The cells are from a lot of 175 cells procured for the International Ultraviolet Explorer project. Due to a change in requirements, the project selected to use 6.0 ampere-hour cells. Therefore, the remaining cells of this lot have been placed in storage at GSFC for use on a future GSFC project. All the cells are rated at 12.0 ampere-hours and contain double ceramic seals. Test limits specify those values in which a cell is to be terminated from a particular charge or discharge. Requirements are referred to as normally expected values based on past performance of aerospace nickel-cadmium cells with demonstrated life characteristics. (auth)

2099 (N--76-27673) FABRICATION AND TESTING OF SEALED SILVER--ZINC CELLS. FINAL REPORT. Donnel, C.P.I. (Yardney Electric Corp., Pawcatuck, Conn. (USA)). Jun 1976. Contract NAS3-16805. 61p. (NASA-CR--135048). NTIS, PC A05/MF A01.

A number of Type HS40-7 sealed silver--zinc cells and experimental 40-Ah sealed silver--zinc cells were fabricated. Cells of each experimental group contained one variation from the standard configuration (HS40-7) cell. Cells from each of five experimental cell groups and cells of the standard configuration were tested to characterize voltage and capacity performance at various discharge rates. The test cells were then subjected to 100 percent DOD Cycle Life Testing at 22 C. Results indicate that material and/or process variations are available which will improve both performance and cycle life of the existing 40 ampere-hour sealed silver--zinc cell configurations. The average cycle life to 50 percent loss of nominal capacity in cells from two (2) of the experimental groups was 150--165 cycles. A series of 12 ampere-hour cells was fabricated and tested as part of a program to incorporate the 40-Ah sealed silver--zinc cell fabrication technology into a cell of smaller size. Base-line configuration cells and experimental variations were produced using the HS40-7 cell fabrication and processing methods adapted to the smaller cell size. (auth)

2100 (N--77-10661) TESTING OF NICD CELLS OVER GEOSTATIONARY ORBIT TYPE CYCLING PERIOD. (Compagnia Generale di Elettricita S.p.A., Milan (Italy). Div. Elettronica). 1975. Contract ESTEC-1185/70-HP. 65p. (ESA-CR(P)--832). NTIS, PC A04/MF A01.

Geostationary orbit type cycling was carried out in order to permit NiCd cell lifetime to be assessed as a function of temperature, charge rate and factor, and depth of discharge in unlimited charge mode operation. A second objective was to collect information on correlation between cell operation in geostationary orbit type cycling and operation under fixed depth of discharge cycling conditions. Tests performed on 180 NiCd cells are described and data collected during 2 years' cycling are presented.

2101 (NASA-CR--120747) NICKEL--CADMIUM BATTERIES FOR APOLLO TELESCOPE MOUNT. Kirsch, W.W.; Shikoh, A.E. (Sperry Rand Corp., Huntsville, Ala. (USA)). 1974. 84p. NTIS.

20 Ah. NICKEL-CADMIUM BATTERIES;SKYLAB; PERFORMANCE TESTING;ELECTRIC POTENTIAL;BATTERY CHARGING

2102 (NASA-CR--120749) EXPERIMENTAL INVESTIGATION AND MODEL DEVELOPMENT OF THE SKYLAB ATM SECONDARY NICKEL--CADMIUM BATTERIES. Kirsch, W.W. (Sperry Rand Corp., New York (USA)). 1974. 69p. TIC.

NICKEL-CADMIUM BATTERIES;PERFORMANCE; FORECASTING;MATHEMATICAL MODELS;TIME DEPENDENCE; TEMPERATURE DEPENDENCE;BATTERY CHARGING;SKYLAB

2103 (NASA-CR--143189) SHORT TEST AND CHARGE RETENTION TEST METHODS FOR NICKEL--CADMIUM SPACECRAFT CELLS. Scott, W.R. (TRW Systems Group, Redondo Beach, Calif. (USA)). 1975. 193p. (N--75-27566). NTIS.

NICKEL-CADMIUM BATTERIES;TESTING;ELECTRIC POTENTIAL;SPACE VEHICLES

2104 (PB--246000) SODIUM--SULFUR BATTERY DEVELOPMENT FOR BULK POWER STORAGE. INTERIM REPORT. Bush, J.B. Jr. (General Electric Co., Schenectady, N.Y. (USA)). Sep 1975. 112p. NTIS $5.50.

This report describes the results obtained in one year of a program that has as its long range objective the development of a practical electrical energy load leveling system based on the sodium--sulfur battery. Seventy-six cells of 17-Ah capacity were cycled continuously until failure occurred. Mechanical seals, which proved to be easier to make and much more reliable then glass or brazed seals, were used exclusively as the exterior seal for the metal cells tested. A variety of alloys (e.g., 347 stainless steel and aluminum and nonmetallic materials such as silicon carbide) were subjected to corrosion testing, and promising materials were incorporated into prototype cells. The average life of cells to abrupt failure has approximately doubled. This has resulted from the elimination of MgO as an additive to the beta alumina. The techniques of x-ray radiography and cell sectioning as well as application of a variety of analytical methods to the examination of components of failed cells have proved valuable in establishing causes of capacity decline and abrupt failure. (GRA)

2105 (PB--251490, pp 210-214) CAPITAL COST CREDITS FOR BATTERY ENERGY STORAGE: COMMENTS ON WORKSHOP RESULTS AND DISCUSSIONS. Kalhammer, F.R. (Electric Power Research Inst., Palo Alto, CA). Mar 1976.

Near-term energy storage technologies: workshop on lead--acid batteries, Palo Alto, California, November 18--19, 1975.

It is anticipated that batteries will not only be able to meet the technical and economic criteria for utility peak shaving and/or load leveling, but also provide a number of specific operating/economic benefits due to their particular electrical properties, compactness, and modular characteristics. It is found that capital cost credits may become a major factor in determining the economic feasibility of lead--acid batteries for utility energy storage. (RWR)

2106 (PB--251594) LAW ENFORCEMENT STANDARDS PROGRAM: NILECJ STANDARD FOR BATTERIES FOR PERSONAL/PORTABLE TRANSCEIVERS. (National Inst. of Law Enforcement and Criminal Justice, Washington, D.C. (USA)). Jun 1975. 16p. (NILE/CJ-STD--0211.00). NTIS $3.50.

Library of Congress Catalog Card No. 75-619245.

The purpose of this document is to establish performance requirements and methods of test for batteries used in personal/portable transceivers by law enforcement agencies. The requirements of this standard are stated with reference to the transceiver model with which the batteries are intended to be used. (GRA)

2107 (PB--260683) EVALUATION OF A 1-KWH ZINC CHLORIDE BATTERY SYSTEM. INTERIM REPORT. Symons, P.C.; Hammond, M.J.; Birk, J. (Energy Development Associates, Madison Heights, Mich. (USA)). Sep 1976. 62p. NTIS, PC A04/MF A01.

A 1-kWh zinc--chlorine battery has been constructed and evaluated for 100 cycles to determine the technical feasibility of this battery system for utility application. The battery was tested under operating conditions appropriate to the peaking application--approximately a 4-hour charge, 4-hour discharge cycle. The battery system uses zinc and

chlorine as the active electrode materials, employs an aqueous circulating electrolyte, and is operated near ambient temperature. The chlorine is stored external to the battery as chlorine hydrate, a frozen ice-like material. The high electrochemical energy efficiency is consistent with the goals for this application. This high energy efficiency and the stability of performance through the 100 charge and discharge cycles suggests this battery is an attractive candidate for development into utility energy storage system.

2108 (SAND--75-0454) SIXTY-MINUTE THERMAL BATTERY. Bush, D.M. (Sandia Labs., Albuquerque, N.Mex. (USA)). Mar 1976. Contract AT(29-1)-789. 20p. Dep. NTIS $4.50.

Investigations to develop a reliable 60-minute thermal battery continued. Results obtained with the latest group of XP60 batteries consisting of 111 units are summarized. Five identical batteries, incorporating design changes resulting from these investigations, had an average life of 69 minutes; all exceeded 60 minutes. Battery tests designed to identify the reactants which cause internal heat generation were also conducted. 6 figures, 4 tables.

2109 (SAND--75-0536) TEMPERATURE AND SHOCK TESTING OF LITHIUM-ORGANIC ELECTROLYTE CELLS. Levy, S.C. (Sandia Labs., Albuquerque, N.Mex. (USA)). Jan 1976. Contract AT(29-1)-789. 17p. Dep. NTIS $4.50.

Honeywell G2655 lithium cells were tested over the temperature range -40° to +70°C and subjected to shock levels up to 17,000 g's. Output at -40°C was approximately 50 percent of that at +25°C, while at +70°C the output was 150 percent that at +25°C. Shock had no noticeable effect on performance. 99 figures, 6 tables. (auth)

2110 (SAND--75-0645) STORAGE AND DISCHARGE TESTS OF LITHIUM-ORGANIC ELECTROLYTE CELLS. Levy, S.C. (Sandia Labs., Albuquerque, N.Mex. (USA)). Mar 1976. Contract AT(29-1)-789. 29p. Dep. NTIS $5.00.

This report provides information on the effects of storage time and temperature, and discharge rate and temperature on the performance of lithium-vanadium pentoxide organic electrolyte cells. 13 figures, 11 tables.

2111 (SAND--75-0646) LITHIUM--ORGANIC ELECTROLYTE CELL STUDIES. Levy, S.C. (Sandia Labs., Albuquerque, N.Mex. (USA)). Mar 1977. Contract EY-76-C-04-0789. 48p. Dep. NTIS, PC A03/MF A01.

Discharge curves of a commercially-produced lithium--organic electrolyte cell under a wide range of storage and discharge conditions are presented. Certain features of these curves are discussed. 40 figures, 10 tables.

2112 (SAND--75-5933) ELECTRICAL AND ENVIRONMENTAL TESTING OF LITHIUM $V_2O_5$ CELLS. II. TEMPERATURE AND SHOCK STUDIES. Levy, S.C. (Sandia Labs., Albuquerque, N.Mex. (USA)). 1975. EY-76-C-04-0789 . 11p. (CONF-760617--2). Dep. NTIS $3.50.

From 27. power sources symposium; Fort Monmouth, New Jersey, USA (21 Jun 1976).

A battery needed to furnish primary power for an instrumentation package has electrical requirements of 34 V maximum to 20 V minimum at 500 mA for three hours over a temperature range of -40°C to +70°C. The battery must be able to withstand a shock of 10,000 g's for 12 ms. Weight and volume restrictions require an energy density of approximately 33 Wh/kg (15 Wh/lb) and 79.3 Wh/dm$^3$ (1.3 Wh/in.$^3$). The cell chosen for testing had a lithium anode, a vanadium pentoxide ($V_2O_5$) cathode, and an electrolyte of lithium hexafluoroarsenate ($LiAsF_6$) plus lithium tetrafluoroborate ($LiBF_4$) in methyl formate. The cell was of a pile-type construction. Twenty-five cells were tested in this program. It was found that the applied shock has no effect on performance, other than an observed decrease of the standard deviation. Over the temperature range studied, performance increased linearly with temperature. The tested cells exceeded the system's electrical requirements at all test conditions. The cells are insensitive to shock levels up to 17,000 g's. 4 figures, 2 tables. (RWR)

2113 (SAND--75-5934) ELECTRICAL AND ENVIRONMENTAL TESTING OF LITHIUM $V_2O_5$ CELLS. I. STORAGE AND DISCHARGE RATE STUDIES. Levy, S.C. (Sandia Labs., Albuquerque, N.Mex. (USA)). 1975. EY-76-C-04-0789 . 14p. (CONF-760617--1). Dep. NTIS $3.50.

From 27. power sources symposium; Fort Monmouth, New Jersey, USA (21 Jun 1976).

Sandia Laboratories has needs requiring long-life, wide-temperature-range primary batteries. One system chosen for study has a lithium anode, a vanadium pentoxide ($V_2O_5$) cathode, and an electrolyte consisting of lithium hexafluoroarsenate ($LiAsF_6$) plus lithium tetrafluoroborate ($LiBF_4$) in methyl formate. The test plan was designed to provide information on performance, storage capability, and a simulated one-year requirement as a function of discharge rate and temperature, as well as storage time and temperature. Five cells were tested at each of 41 subtests, and the data were averaged. Average currents corresponded to the one-year rate and 5, 10, or 20 times the one-year rate. It was found that the system examined cannot meet performance requirements for a long-life, wide-temperature battery over the temperature range -54°C to +71°C, nor can it survive extended storage at elevated temperatures. However, it can survive up to one year's storage at room temperature or below and up to 100 days storage at +57°C; and over a temperature range of -32°C to +57°C it is capable of meeting the performance requirements. 5 figures, 1 table. (RWR)

2114 (X--711-77-28, pp 13-27) VIBRATIONAL EFFECTS ON SEALED NICKEL--CADMIUM CELLS. Gross, S. (Boeing Aerospace Co., Seattle). Nov 1976.

From 9. annual battery workshop; Greenbelt, Maryland, USA (9 Nov 1976).

1976 Goddard Space Flight Center battery workshop.

The effects of strenuous vibration on sealed nickel--cadmium cells were studied. Causes of cell failure and methods to eliminate them were investigated. It was learned that compression improves resistance to vibration. A design curve was obtained. Compression also separates the natural frequencies of the battery case and the cell. 24 figures. (RWR)

2115 (X--711-77-28, pp 55-67) CYCLE LIFE PERFORMANCE TESTING, HELIOTEK 50-AMPERE HOUR CELLS. Pickett, D. (Wright-Patterson Air Force Base, OH). Nov 1976.

From 9. annual battery workshop; Greenbelt, Maryland, USA (9 Nov 1976).

1976 Goddard Space Flight Center battery workshop.

Construction and performance testing of Ni/Cd cells for geosynchronous satellite usage are discussed. Low end-of-discharge voltages and high charge voltages were noted; these were attributed to insufficient electrolyte. 18 figures. (RWR)

2116 (X--711-77-28, pp 71-80) ACCELERATED TEST. McDermott, P. (Coppin State Coll., Washington, DC). Nov 1976.
From 9. annual battery workshop; Greenbelt, Maryland, USA (9 Nov 1976).
1976 Goddard Space Flight Center battery workshop.
If accelerated test data are to be correlated with real life test data, it is necessary that failures in accelerated tests be understood. The author examined accelerated test results from the point of view of the chemical changes going on, not in terms of regression or statistical analysis, and attempted to correlate them with modes of failure or degradation. 7 figures. (RWR)

2117 (X--711-77-28, pp 81-87) JPL TEST PLAN FOR EVALUATION OF NEW TECHNOLOGY, NICKEL--CADMIUM CELLS. Bogner, R.S. (Jet Propulsion Labs., Padadena, CA). Nov 1976.
From 9. annual battery workshop; Greenbelt, Maryland, USA (9 Nov 1976).
1976 Goddard Space Flight Center battery workshop.
The objective of the test plan was to compare different Ni-cad cell types to determine life in comparison to the Goddard Space Flight (GSF) cells on the accelerated life test program. A second objective was to determine if the regression equation for the life of the GSF cells is appropriate for other cells and cell sizes. A factorial experiment was designed; factors of concern at JPL were KOH concentration, precharge, and KOH volume. Cells of 6, 20, and 25 Ah were to be tested. The testing program was still underway. 8 figures. (RWR)

2118 (X--711-77-28, pp 89-95) CELL DESIGN. Baer, D. Nov 1976.
From 9. annual battery workshop; Greenbelt, Maryland, USA (9 Nov 1976).
1976 Goddard Space Flight Center battery workshop.
Six- and 12-Ah Ni/Cd cells manufactured for the IUE program are compared. Cell design, manufacturing data, and acceptance test data obtained at GE and Goddard are included. The cells were GE cells with dual nickel braze, ceramic-to-metal seals, and pellon 2505 separator; negatives were teflonated. Pressures and cell voltages are tabulated. Five cells were cycled as for a 24-h orbit; initially there was a capacity at 0C of 6.3 Ah, but this increased to 7.1 Ah after about 50 cycles. 7 figures. (RWR)

2119 (X--711-77-28, pp 105-109) BATTERY CELL DESIGN PRIORITIES FOR GEOSYNCHRONOUS ORBIT COMMUNICATIONS SATELLITE. Steinhauer, R. (Hughes Aircraft Co., Los Angeles). Nov 1976.
From 9. annual battery workshop; Greenbelt, Maryland, USA (9 Nov 1976).
1976 Goddard Space Flight Center battery workshop.
A brief overview is given on what constitutes a communications satellite system and how the battery requirements are determined. Batteries are about 1% of the cost and 10% of the mass of an on-station satellite. What is needed is a battery which will perform well for 1000 to 2000 charge/discharge cycles to nearly 80% depth of discharge over 10 to 15 years. Long life must not be sacrificed for high energy density. 4 figures. (RWR)

2120 (X--711-77-28, pp 111-127) NICKEL--CADMIUM, STATE-OF-THE-ART ASSESSMENT OF COMMUNICATIONS SATELLITES. Krause, S. (Hughes Aircraft Co., Los Angeles). Nov 1976.
From 9. annual battery workshop; Greenbelt, Maryland, USA (9 Nov 1976).
1976 Goddard Space Flight Center battery workshop.
Data from typical synchronous satellite battery life tests are shown. These examine electrode thickness vs time, chemical composition of electrodes, time dependence of electrolyte in separators and electrodes, time dependence of cadmium migration, etc. Predominant wearout mechanisms are considered, and steps required to obtain Ni-cad systems of very long life are suggested. Research in separator properties and reaction kinetics will probably be needed. 18 figures. (RWR)

2121 (X--711-77-28, pp 185-190) RECONDITIONING OF RCA STATCOM BATTERIES IN ORBIT. Napoli, J. (RCA American Communications, Piscataway, NJ). Nov 1976.
From 9. annual battery workshop; Greenbelt, Maryland, USA (9 Nov 1976).
1976 Goddard Space Flight Center battery workshop.
Background information on the SATCOM cells, their history, and how long they have been operating is presented. The SATCOM design is a direct energy transfer power system. There are three batteries of 22 cells each, on a parallel charge; that is, each battery has its own charger. Basic cell design and operating parameters are tabulated. Cells have operated in orbit about a year so far, and have been reconditioned twice. Data on battery voltages are shown. 5 figures. (RWR)

2122 (X--711-77-28, pp 191-197) PERFORMANCE CHARACTERISTICS OF RECONDITIONED BATTERIES ON THE CTS. Lackner, J. (Defense Research Establishment, Shirley Bay, Ont.). Nov 1976.
From 9. annual battery workshop; Greenbelt, Maryland, USA (9 Nov 1976).
1976 Goddard Space Flight Center battery workshop.
Data on battery reconditioning performed on cells in the Communication Technology Satellite are presented. Principal cell design and operating characteristics are given. The change in voltage of the 5-Ah (nominal) Ni/Cd batteries during reconditioning is shown. 4 figures. (RWR)

2123 (X--711-77-28, pp 199-213) LIFE TESTS AND RECONDITIONING. Scott, W.R. (TRW Systems, Redondo Beach, CA). Nov 1976.
From 9. annual battery workshop; Greenbelt, Maryland, USA (9 Nov 1976).
1976 Goddard Space Flight Center battery workshop.
Some data on ground life tests involving reconditioning are presented. Accelerated synchronous-orbit-type tests were done on batteries with polypropylene and with nylon separators; the tests were continued for 14 and 10 eclipse seasons, respectively. Maximum, minimum, and mean end-of-discharge voltages are plotted, and the effects of reconditioning are shown. It is concluded that, after a battery has been discharged extensively, particularly at high depths of discharge (84%), the method of reconditioning is very important. Discharge to a relatively high battery voltage becomes

less and less effective as the number of cycles increases; one must discharge the cells to a much lower voltage. A comparison between cells which were and were not reconditioned is also made. Rather extensive discussion followed this paper. 4 figures. (RWR)

2124 (X--711-77-28, pp 215-222) CYCLE LIFE AND STORAGE TEST RESULTS. Bogner, R.S. (Jet Propulsion Labs., Pasadena, CA). Nov 1976.
From 9. annual battery workshop; Greenbelt, Maryland, USA (9 Nov 1976).
1976 Goddard Space Flight Center battery workshop.
Nickel--cadmium cycle life and storage test results are discussed. A description of the test cells, previous test history, cycle test outline and results, and storage test outline and results are presented. Thirty cells were purchased from each of three manufacturers. It was concluded from the storage test that no one storage was significantly better than another. 11 figures. (RWR)

2125 (X--711-77-28, pp 223-228) ACCELERATED LIFE TESTS ON NATO III BATTERIES. Armantrout, J.D. (Aeronutronic Ford, Palo Alto, CA). Nov 1976.
From 9. annual battery workshop; Greenbelt, Maryland, USA (9 Nov 1976).
1976 Goddard Space Flight Center battery workshop.
Information on a 20-Wh/lb battery is presented. The test procedures are described. Effects of capacity degradation are pointed out. The difference between maximum and minimum end-of-discharge voltages increased until about the fifth eclipse season and then diminished, regardless of whether the cells were reconditioned or not. It was concluded that lightweight battery packaging design did demonstrate the capability to meet seven-year mission requirements. The reconditioning tends to improve early-life discharge voltage performance and also the end-of-life discharge capacity characteristics. It was found that the reconditioned portion of the battery had approximately 25% more capacity at the end of the test than the unreconditioned. 5 figures. (RWR)

2126 (X--711-77-28, pp 229-232) HEAO CELL PARAMETRIC TESTS. Paschal, E. (Marshall Space Flight Center, Huntsville, AL). Nov 1976.
From 9. annual battery workshop; Greenbelt, Maryland, USA (9 Nov 1976).
1976 Goddard Space Flight Center battery workshop.
The results of the parametric testing on the HEAO cell, a 20-ampere SAFT cell, are presented. This is a comparison between two production runs, approximately a year apart. The designs between the two production runs were different. The plate loading on group 2 was lower. The positive capacity was similar for the two groups, but the negative capacity was substantially higher for the first group. Results for group 1 at the end of 500 cycles were lower than those for group 2 at 1000 cycles. 3 figures. (RWR)

2127 (X--711-77-28, pp 245-253) VIKING BATTERY GROUND AND FLIGHT TEST RESULTS. Newell, B. (Martin Marietta Corp., Denver). Nov 1976.
From 9. annual battery workshop; Greenbelt, Maryland, USA (9 Nov 1976).
1976 Goddard Space Flight Center battery workshop.
Data on the polypropylene cells used on the Viking mission are presented. Cell specifications, characteristics, and steps in manufacturing are tabulated. Plots of the following information are given: cell self-discharge characteristic, effects of trickle charge on voltage, end-of-charge and end-of-discharge voltages as functions of thousands of cycles, and battery and cell voltage characteristics after 8568 cycles. 13 figures. (RWR)

2128 (X--711-77-28, pp 255-265) VIKING ORBITER BATTERY DESIGN AND PERFORMANCE. Bogner, R.S. (Jet Propulsion Labs., Pasadena, CA). Nov 1976.
From 9. annual battery workshop; Greenbelt, Maryland, USA (9 Nov 1976).
1976 Goddard Space Flight Center battery workshop.
The design of the spacecraft and the battery is described. A battery performance mission simulation test is discussed, and data on battery performance during the actual mission of the VO I spacecraft are presented. Some problems arising during procurement and fabrication of the battery are summarized. 8 figures. (RWR)

2129 (X--711-77-28, pp 267-272) NICKEL HYDROGEN BATTERY HAZARDOUS TEST FACILITY. Gandel, M. Nov 1976.
From 9. annual battery workshop; Greenbelt, Maryland, USA (9 Nov 1976).
1976 Goddard Space Flight Center battery workshop.
A chamber for the testing of nickel/hydrogen batteries is described. Special precautions are necessary, of course, because of the presence of hydrogen. The discussion following this paper pointed out the evolution of hydrogen from nickel/cadmium batteries, and suggested that Ni/$H_2$ batteries might actually be the safer ones. 3 figures. (RWR)

2130 (X--711-77-28, pp 285-289) SILVER--HYDROGEN LIFE TESTING. Armantrout, J.D. (Aeronutronic Ford, Palo Alto, CA). Nov 1976.
From 9. annual battery workshop; Greenbelt, Maryland, USA (9 Nov 1976).
1976 Goddard Space Flight Center battery workshop.
Data on the Ag/$H_2$ system are discussed. The stack configuration and charge--discharge characteristics are shown. The following conclusions were reached: the Ag/$H_2$ energy storage system has a demonstrated cycle life capability of at least 2000 deep discharge cycles and a calendar life of at least one year; optimum charge control of Ag/$H_2$ cells improves cell performance and eliminates cell stack electrolyte loss; replacement of the Ni/$H_2$ system with Ag/$H_2$ should significantly improve space battery energy density and simplify electrolyte and thermal management requirements. 4 figures. (RWR)

2131 (X--711-77-28, pp 297-309) FAILURE MECHANISMS IN NICKEL--HYDROGEN CELLS. Holleck, G. (EIC Corp., Newton, MA). Nov 1976.
From 9. annual battery workshop; Greenbelt, Maryland, USA (9 Nov 1976).
1976 Goddard Space Flight Center battery workshop.
Results of experimental investigations of proposed solutions to the problem of failure in Ni/$H_2$ cells are discussed. The overall program includes component-level investigations geared to identifying the important steps and the

mechanisms associated with oxygen and electrolyte management, demonstration of the feasibility of cells with improved design, and construction of experimental cells for extensive testing. Specific studies involved electrodes, oxygen recombination, electrolyte loss from the stack and its prevention. The main conclusions of this part of the work were that oxygen concentration is determined by diffusion path and that the principal electrolyte loss mechanism is displacement; the solution was incorporation of reservoirs and membranes in an appropriately designed stack configuration. Several designs are shown, and test data are presented. The following conclusions were drawn: lack of electrolyte limits high-rate performance; the main electrolyte loss mechanism is displacement; high thermal gradients lead to $H_2O$ loss; $O_2$ concentration is acceptable in conventional arrangements, but lowest in a recirculating configuration; trapped $O_2$ is larger in cells with a reservoir. The recommendation is for a cell configuration with optimized reservoir. 20 figures. (RWR)

2132 (X--711-77-28, pp 311-315) OXYGEN EQUILIBRIUM MEASUREMENTS IN NICKEL--HYDROGEN CELLS. Rogers, H.H. (Hughes Aircraft, Los Angeles). Nov 1976.
From 9. annual battery workshop; Greenbelt, Maryland, USA (9 Nov 1976).
1976 Goddard Space Flight Center battery workshop.
Different workers reported very large differences in the oxygen concentration in Ni/$H_2$ cells. The object of this work was to determine if EIC and ERD hydrogen electrodes have different activity for oxygen reduction. Apparatus and procedures for making the measurement are described, and a typical electrode recorder trace is shown. The following results were obtained: temperature increased from 22.5° to 47°C; current increased about 20%; $O_2$ solubility was lower; and diffusion rate was greater. The effects of temperature rises were studied. It was found that the differences reported were due to differences in the electrodes. The reaction is diffusion limited, as indicated by the small temperature coefficient. TFE backing can reduce the recombination rate significantly. Electrodes should be designed for high activity with diluted oxygen, and characterized for oxygen recombination before use in Ni/$H_2$ cells. 8 figures. (RWR)

2133 (X--711-77-28, pp 327-335) CYCLE LIFE TEST AND THERMAL VACUUM TEST RESULTS IN NICKEL--HYDROGEN CELLS. Sayano, R. (TRW Systems, Redondo Beach, CA). Nov 1976.
From 9. annual battery workshop; Greenbelt, Maryland, USA (9 Nov 1976).
1976 Goddard Space Flight Center battery workshop.
The first part of this paper contains a summary of life cycle tests on nickel--hydrogen cells of various vintages. The second part presents results of thermal vacuum tests on 10-cell, 35-Ah Ni/$H_2$ batteries designed and fabricated under the sponsorship of Comsat. End-of-discharge cell voltages are shown. Engineering details involved in performing the tests are elucidated. 12 figures. (RWR)

2134 ANODIC DISSOLUTION OF LEAD IN OXYGENATED AND DEOXYGENATED SULPHURIC ACID SOLUTIONS. Armstrong, R.D.; Bladen, K.L. (Univ. Newcastle-Upon-Tyne, Eng.). J. Appl. Electrochem.; 7: No. 4, 345-353(Jul 1977).
Steady-state and impedance measurements were carried out in oxygenated and deoxygenated sulfuric acid solutions to investigate the effects of dissolved oxygen. Impedance measurements in deoxygenated sulfuric acid were used to determine values of C/sub o/. 4 figures, 2 tables.

2135 NEW RATING STANDARDS FOR AUTOMOTIVE BATTERIES. II. Bennett, R.L. Battery Man; 19: No. 7, 13-15(Jul 1977).
The history of attempts to devise an accelerated laboratory life test to indicate how long a battery would operate in normal car service is recounted. Various tests which have been used are described. Battery failure modes are tabulated. The test procedure presently recommended is detailed. 3 figures, 1 table. (RWR)

2136 NEW RATING STANDARDS FOR AUTOMOTIVE BATTERIES. Bennett, R.L. Battery Man; 19: No. 6, 11-13(Jun 1977).
The Battery Subcommittee of the SAE Electrical Equipment Committee developed new standards for rating automotive batteries. The need for the new ratings and their advantages over the former ratings are discussed along with the new ''Reserve Capacity,'' ''Cold Cranking,'' and ''Life Test'' test procedures. These new standards closely simulate actual operating conditions in today's cars, and their adoption will allow the battery suppliers increased design flexibility. 4 figures, 1 table.

2137 CORROSION OF LITHIUM IN ALKALINE SOLUTION. Littauer, E.L.; Tsai, K.C. (Lockheed Palo Alto Research Labs., CA). J. Electrochem. Soc.; 124: No. 6, 850-855(Jun 1977).
The corrosion of Li was studied in 3-5M LiOH at 25°C and in 4.5M LiOH at 4°-60°C. The Arrhenius relationship is obeyed and the apparent activation energy for the Li corrosion reaction is found to be 15.5 kcal $mole^{-1}$. An empirical relationship is derived from which the corrosion rate, v/sub f/, can be obtained at any molar LiOH. At 25°C v/sub f/(kA $m^{-2}$) = 0.31(54.1 - 10[LiOH]). An equation is also given which allows calculation of the Li corrosion rate when the metal is anodically polarized. The kinetics of the $H_2$ evolution reaction (e.r.) on Li were determined, the transfer coefficient $\alpha$ has a value of 0.14. The rate-controlling process of the Li dissolution reaction is the highly polarized $H_2$ evolution at cathodic sites. Based on the $\alpha$ value obtained, the enthalpy of activation for the $H_2$ e.r. on Li at OCV is calculated to be 22.8 kcal $mole^{-1}$. It is proposed that the protective film on Li has a duplex structure with a thin oxide/hydroxide layer adjacent to the metal and an outer porous hydrated layer through which the reaction products and reactants can pass freely. 7 figures.

2138 TEMPERATURE INFLUENCES BATTERY LIFE AND PERFORMANCE. Zalecki, J.J. Battery Man; 19: No. 4, 18-20(Apr 1977).
The importance of proper voltage regulator setting for operation at differing temperatures is emphasized. Battery counter emf is higher at low temperatures and lower at high temperatures--the voltage regulator must be able to allow for this to deliver proper charging current to the battery. New, low-antimony batteries lessen the danger of overcharging at elevated temperatures to a considerable extent. (RWR)

2139 WHY ALKALINE CELLS LEAK. Hull, M.N.; James, H.I. (ESB Inc., Yardley, PA). J. Electrochem. Soc.; 124: No. 3, 332-339(Mar 1977).

The creepage of alkaline electrolytes along negatively polarized electrodes was studied experimentally and theoretically. One driving force for this phenomenon is the production of $OH^-$ ions arising from the electrochemical reduction of oxygen and/or the evolution of hydrogen occurring in a thin reaction zone above the observed electrolyte meniscus. Movement of water into this zone causes it to thicken and increase in conductivity with the result that the reaction zone moves along the electrode. 15 figures.

2140 KINETICS ON THE POTENTIOSTATIC OXIDATION OF LEAD SULFATE FILMS ON LEAD IN SULFURIC ACID SOLUTION. Valeriote, E.M.L.; Gallop, L.D. (Defence Research Establishment, Ottawa). J. Electrochem. Soc.; 124: No. 3, 370-380(Mar 1977).

Models proposed by Pavlov and Ruetschi to describe the multiphase electrode structure of anodically oxidized lead/sulfuric acid solutions were quantitatively tested, modified, and elaborated in accordance with the experimental evidence. The current during oxidation at constant potential in the region of lead dioxide formation is shown to be controlled sequentially by at least three diffusion processes, followed by at least two electrocrystallization stages and further intervals of diffusion control. The natures and concentrations of the diffusing species are quantitatively characterized on the basis of kinetic and thermodynamic data. The corresponding values of pH in the electrode pores are calculated. A reversal of the pH gradient in the pores apparently occurs in close association with the onset of $\beta$-$PbO_2$ production. It is following this stage of the anodic oxidation that the charging kinetics become qualitatively dependent on temperature. At normal temperatures, growth of $\beta$-$PbO_2$ at the expense of lead sulfate occurs. At very low temperatures this process is blocked, and poor subsequent charge acceptance results. 6 figures, 4 tables.

2141 LOW TEMPERATURE OXIDATION KINETICS OF ANODIC FILMS ON LEAD IN SULFURIC ACID SOLUTION. Valeriote, E.M.L.; Gallop, L.D. (Defence Research Establishment, Ottawa). J. Electrochem. Soc.; 124: No. 3, 380-387(Mar 1977).

A multiphase model of anodic films on lead in sulfuric acid, previously developed to describe the oxidation of lead at room temperature, was applied to potentiostatic transient data at very low temperatures (0° to -50°C). Freezing of the dilute pore electrolyte is proposed, such that ionic diffusion and equilibria must occur in a thin layer of adsorbed water between the ice and pore walls. The experimentally determined activation energies and entropies of diffusion indicate that desorption of water or dehydration of ions plays an important role in the activation process. Except for the effects of the more limited electrolyte volume within the pores upon freezing, the electro-oxidation processes follow a similar sequence above and below the freezing point. However, eventual reactant depletion, due to kinetically hindered equilibria and reduced electrolyte volume in the pores, leads to cessation of charge acceptance at very low temperatures, before appreciable $\beta$-$PbO_2$ formation can occur. 7 figures, 2 tables.

2142 ANODIC EVOLUTION OF SULPHUR FROM SODIUM POLYSULPHIDE MELTS. I. VOLTAMMETRIC MEASUREMENTS ON PLANAR CARBON ELECTRODES. Brennan, M.P.J. (Chloride Silent Power Ltd., Runcorn, Eng.). Electrochim. Acta; 22: No. 3, 279-283(Mar 1977).

The anodic evolution of sulfur from sodium polysulfide melts was studied at planar vitreous carbon and pyrolytic graphite electrodes. A reaction mechanism is proposed, in which the primary product of the electrode reaction is a partly discharged polysulfide anion, which undergoes chemical reactions in the diffusion layer to form sulfur. Phase formation is primarily a homogeneous process which does not proceed to a passivating film of sulfur upon the electrode. At high cd nucleation can occur upon the electrode leading to passivation, but the sulfur formed in this way does not wet the electrode, and depassivation can occur spontaneously. 10 figures, 2 tables.

2143 APPLICATIONS OF NON-EQUILIBRIUM THERMODYNAMICS TO THE THEORY OF OVERVOLTAGE. Nagy, Z. (Diamond Shamrock Corp., Painesville, OH). Electrochim. Acta; 22: No. 2, 191-195(Feb 1977).

An unambiguous definition of the different overpotential terms is possible based on the theory of non-equilibrium thermodynamics. The overpotentials are a direct consequence of the thermodynamic irreversibility of the processes taking place in an electrochemical system, and the irreversible entropy production of a process occurring at a finite rate is a quantitative measure of this irreversibility. Therefore, the overpotential terms can be directly defined in terms of the entropy production rate of the process in question, T $\Sigma$/sub i/(dS/sub i//dt) = I $\Sigma$/sub i/eta/sub i/, with eta/sub i/ = (T/I)(dS/sub i//dt). Two examples are given: the separation of ohmic and diffusion overpotentials and the separation of the charge transfer and diffusion overpotentials. 1 figure.

2144 DISCHARGE CHARACTERISTIC AND PERFORMANCE OF LITHIUM-SILVER TUNGSTATE AND LITHIUM-SILVER MOLYBDATE ORGANIC SOLVENT BATTERIES. DiPietro, B.; Scrosati, B. (Univ of Rome, Italy). J. Electrochem. Soc.; 124: No. 2, 161-164(Feb 1977).

The discharge characteristic and performance of the Li/$Ag_2WO_4$ and Li/$Ag_2MoO_4$ couples in $LiAsF_6$--$\gamma$-butyrolactone are reported in terms of discharge mechanism, polarization, and cathode efficiency. In both cases, the discharge process seems to be characterized by two distinct plateaus. Attention has been mainly focused on the first plateau of the two systems, and by means of x-ray and coulometric analyses it has been possible to relate to these plateaus the electrochemical processes consisting of the formation of silver and lithium tungstate, and silver and lithium molybdate, respectively.

2145 NICKEL-CADMIUM CELLS. Johnson, K.C. Wireless World; 83: No. 1494, 47-48(Feb 1977).

A theory is proposed as to why nickel--cadmium cells fail. A procedure which, it is claimed, can revive failed cells is described.

2146 SUPERBATTERIES DUE ON MARKET IN EIGHT YEARS. Electr. World; 187: No. 1, 21-22(1 Jan 1977).

Several methods of energy storage (pumped hydro, compressed gas, thermal, advanced

batteries) are briefly described and compared with respect to economic competitiveness. Batteries could be located throughout a utility system. Four advanced systems currently under development and their operating temperatures are zinc--chlorine (50°C), lithium--iron sulfide (450°C), sodium--sulfur (300°C), and sodium--antimony chloride (200°C). High temperatures promote better electrode performance but present problems of electrical, chemical, and thermal corrosion. These may be resolved through coating of low-cost materials with corrosion-resistant substances. 1 figure. (RWR)

2147 INTERFEROMETRIC STUDY OF LOW TEMPERATURE CHARGING OF THE LEAD--ACID CELL. O'Brien, R.N. (Univ. of Victoria, BC). J. Electrochem. Soc.; 124: No. 1, 96-98(Jan 1977).

Solution conditions accompanying low-temperature (-20°C) resistance to charge acceptance were investigated. A plot of the potential required to charge a cell at 10.00 mA/CM² at temperatures between -20° and -24°C is given. 3 figures (RWR)

2148 DON'T CHARGE BATTERIES AT END OF SHIFT. Schultz, G.V. Fact. Manage. Maint.; 10: No. 1, 44-47(Jan 1977).

This article shows how charging lift truck batteries only when each reaches the 80%-discharge point can produce broad savings, and describes new battery discharge indicators (BDIs) for implementing the proposed routine. The new BDIs are of the ''fuel gage'' type successfully used on the Lunar Rover. Most incorporate a warning light, appearing at about 75% discharge, to alert the truck operator before an automatic lockout of some of the truck's functions (of mast, or lift, for example) occurs, allowing the operator just enough power to reach the charging station. The reduction in energy consumption using the proposed routine, as compared with end-of-shift recharging (regardless of charge left), has been hypothesized at 15%, with a lowering of peak demand charges (where these are in effect) of the order of 40%.

2149 PROPOSALS FOR FURTHER DEVELOPMENT OF ENERGY STORAGE SYSTEMS FOR ELECTRIC ROAD VEHICLES. Thomas, R.; Zander, E. Elektrotech. Z., A; 98: No. 1, 64-69(Jan 1977). (In German).

From 4. international electric vehicle symposium; Duesseldorf, Germany, F.R. (31 Aug - 2 Sep 1976).

On the basis of operational experience gained so far with electric road vehicles and their electrical supply from the available public middle and low voltage system, suggestions are made for the further development of storage systems for electric vehicles. The requisite power and output densities are based here also on the traffic demands on the vehicle and are viewed from the point of view of the power supply. Further, the report shows that the behaviour of the battery during temperature rise, partial cycles, under mechanical stresses, and not least its charge and discharge efficiency are of decisive importance. With reference to economy attention is drawn to the necessity for simple maintenance of the battery at the longest possible intervals.

2150 NEW RATING STANDARDS FOR AUTOMOTIVE BATTERIES. Bennett, R.L. Warrendale, PA; Society of Automotive Engineers (1977). 9p. (CONF-770205--29).

From Conference of the SAE International Automotive Engineering Congress and Exposition; Detroit, Michigan, USA (28 Feb 1977).

The Battery Subcommittee of the SAE Electrical Equipment Committee developed new standards for rating automotive batteries. The need for the new ratings and their advantages over the former ratings are discussed along with the new ''Reserve Capacity,'' ''Cold Cranking, and ''Life Test'' test procedures. These new standards closely simulate actual operating conditions in today's cars, and their adoption will allow the battery suppliers increased design flexibility. 7 figures, 2 tables.

2151 RESPONSE OF STANDARD CELLS TO ALTERNATING CURRENTS IN THE FREQUENCY RANGE 10--$10^5$ HZ. Sloggett, G.J. (CSIRO, Natl Meas Lab, Chippendale, Aust). Metrologia; 13: No. 2, 57-61(1977).

Measurement of the effects of passing alternating currents in the frequency range 10--$10^5$ Hz through a group of saturated standard cells shows that their internal resistances decline with increasing frequency at a mean rate of 25 Ω/decade. Ac causes the emf's of certain cells to decrease, whereas only increases have been previously reported. For most cells, this effect becomes very small for frequencies above 1 kHz. Also, a previously unreported phenomenon, the generation of an emf at twice the ac frequency, is observed. A simple relationship between the magnitude of this effect and that of emf change is suggested.

2152 OPTIONS IN MAINTENANCE-FREE BATTERIES. Sikora, J.I. Battery Man; 18: No. 12, 2, 4-5(Dec 1976).

The concept of the maintenance-free (mf) battery is explained. Characteristics of several types of mf batteries are discussed. The benefits of the new batteries and the importance of proper installation are pointed out. (RWR)

2153 LIFE CYCLE TESTING OF SLI BATTERIES WITH PB--CA--SN GRIDS CONTAINING VARIOUS AMOUNTS OF BISMUTH. Devitt, J.L.; Myers, M. J. Electrochem. Soc.; 123: No. 12, 1769-1772(Dec 1976).

The effects of battery life of lead--calcium--tin grids (Pb + 0.07% Ca + 0.7% Sn) with bismuth content in the range 7 to 420 ppM were studied. Full-sized batteries were cycled to failure by using either modified SAE J240 or J537 procedures. The results showed that, in the test designed to cause failure by corrosion (SAE J537), no ill effects due to bismuth were noted. In the tests designed to model automotive service (J240), cycle life tended to increase with increasing bismuth content of the grids. 2 figures, 4 tables.

2154 NEW GENERATION OF PROPULSION BATTERIES FOR MINING LOCOMOTIVES IN AREAS WITH EXPLOSIVE ATMOSPHERES. Kiehne, H.A. Bergbau; 27: No. 12, 503-506(Dec 1976). (In German).

11 figs..

Within the framework of harmonization activities for safety regulations, a Cenelec draft (EN 50034 electrical equipment for explosive atmospheres -- equipment for ignition protection type 'e', increased safety, accumulators) was elaborated by a group of international experts. The article summarizes the general requirements made on the new battery generation as contained in draft EN

50034, and introduces some types of the new batteries.

2155 RESEARCHERS STUDY NEW BATTERIES. Electr. Veh. Batteries; 62: No. 4, 21(Dec 1976).

A new type of batterywhich, it is believed, could store up to 20 times more energy for its size and weight than the present lead--acid kind is being investigated by a U.S. Government sponsored research team at the Energy Research and Development Administration's Lawrence Livermore Laboratory in California. Concurrently, tests with nickel--zinc batteries are being undertaken by the National Aeronautics and Space Administration's Lewis Research Center in Cleveland, Ohio. As a part of their studies, the Lawrence Livermore researchers are exploring similar batteries based on reactive but potentially less expensive metals such as calcium, magnesium, aluminum, sodium and their alloys. These batteries are of the primary type; they are ''recharged'' by replacing the lithium rather than by being recharged electrically. A sample nickel--zinc battery at NASA Center makes use of cells produced by two industrial contractors, a feature of which is an inorganic separator adapted from space battery technology. The battery has been installed in an electric utility van, using a battery weight equivalent to the conventional lead--acid type. Tests have shown that with the nickel--zinc battery it was possible to make almost twice as many stop--start driving cycles per charge as with the lead--acid battery (190 to 99). Driven at a constant speed of 20 mph, the van ran for 54.9 miles with the nickel--zinc battery and only 29.4 miles with the lead--acid before recharging was necessary.

2156 CARE AND FEEDING OF THE ''NEW BABY''. Zalecki, J.J. Battery Man; 18: No. 11, 26-27(Nov 1976).

The proper procedures for installation and testing of maintenance-free batteries are reviewed. Battery charging and storage are also discussed. (RWR)

2157 POLARITY REVERSAL PHENOMENA IN NICKEL--CADMIUM CELLS. Hodgman, J.S. (General Electric Plastics G.m.b.H., Ruesselsheim (Germany, F.R.). Battery Dept.). Ind.-Elektr. Elektron.; 21: No. 19, 420-421(Nov 1976). (In German).

2 figs..

Chargeable NiCd batteries consist of a number of single cells connected in series in order to achieve the voltage desired for a particular use. If these batteries are discharged to a large extent, this can result in a so-called 'reversed cell polarity'. What this effect causes, what happens to a 'reversely polarized' cell and how battery engineers have solved this problem are described.

2158 STORAGE BATTERIES: THE CASE AND THE CANDIDATES. Whitaker, R.; Birk, J. EPRI J.; 1: No. 8, 6-13(Oct 1976).

The basic purpose that storage of energy can serve in the electric power industry as a functional alternative to intermediate- and peak-demand generators is explored, and economic considerations of batteries as storage facilities are discussed. The many and obvious advantages of batteries for utility load leveling are enumerated. The different types of batteries, namely the lead--acid battery and the advanced design batteries, are discussed as to advantages, disadvantages, and cost/kWh. Certain characteristics of different advanced designs now getting the most attention, sodium--sulfur, sodium--antimony trichloride, lithium--metal sulfides, and zinc--chlorine, are tabulated. Dollar costs are a determining factor in whether or not batteries supply the need for energy storage facilities. (BLM)

2159 MATHEMATICAL MODEL OF A LITHIUM--WATER ELECTROCHEMICAL POWER CELL. Bennion, D.N.; Littauer, E.L. (Univ. of California, Los Angeles). J. Electrochem. Soc.; 123: No. 10, 1462-1469(Oct 1976).

A mathematical model is developed which describes the operation of a lithium--water, electrochemical power cell. The current density, current efficiency, power density, and specific energy are calculated as functions of cell potential, lithium hydroxide concentration, temperature, electrolytic solution flow velocity, position along the flow channel, spacing between electrodes, and flow channel width. Anode-to-cathode contact pressure is not included in this initial model. A large dependence of power density on LiOH concentration is predicted. For example, at an LiOH concentration of 2M, a power maximum of 394 $mW/cm^2$ is calculated, and in 5M LiOH the power maximum is calculated to be 25 $mW/cm^2$. Temperature and flow velocity show similar but smaller effects.

2160 CUSTOM CHARGERS AND MATCHED CELLS INCREASE LIFE OF SEALED BATTERIES. Yeaple, F. Prod. Eng. (N.Y.); 47: No. 10, 21-24(Oct 1976).

Totally sealed lead-acid battery now competes with nickel-cadmium battery for portable appliances. Each is available in a design that vents no gases or liquids. Two kinds of lead-acid cells are finding increasing applications: the gelled electrolyte and the absorbed electrolyte. In this article, only the absorbed-electrolyte type is compared with the NiCd cell, because they have similar applications: each is abused by overcharge and neglect, yet is not expected to vent or to lose water. The differences in charging techniques are also examined.

2161 UNWANTED MEMORY SPOOKS NICKEL--CADMIUM CELLS. Pensabene, S.F.; Gould, J.W. II. (General Electric Co., Gainesville, FL). IEEE Spectrum; 13: No. 9, 33-36(Sep 1976).

The ''memory'' effect is defined as ''an apparent reduction in capacity to a predetermined discharge voltage cut-off point (usually one volt) resulting from repetitive use patterns.'' The phenomenon was first noticed in satellite test programs in which cells received a carefully controlled charge/discharge regime at constant temperature, over and over again. The phenomenon is rather rare. After a brief discussion identifying the main components within a sintered-plate cell (the only type affected), the suspected cause of ''memory'' and the reasons for its rarity are explained. ''Memory'' is thought to be caused by lost of simultaneous, intimate contact between the plates, impregnated active chemicals and electrolyte. Since these contacts are not easily lost in a well-constructed cell, the ''memory'' effect is rare. 3 figures. (RWR)

2162 MATERIALS BALANCE IN PRIMARY BATTERIES. 4. LITHIUM BATTERIES WITH ORGANIC ELECTROLYTES. Marincic, N. (GTE Lab., Inc., Waltham, MA). J. Appl. Electrochem.; 6: No. 5, 463-468(Sep 1976).

The stoichiometric characteristics of discharge reactions ($k_1$ and $k_3$) were defined for six different lithium battery systems and the cathode discharge characteristics ($k_2$) were determined on the basis of the experimental data reported by various authors. These characteristics were then applied in the optimization procedure developed earlier to predict the maximum cell capacity obtainable at low discharge rates. The values predicted were compared with those reported by various authors; this comparison suggests the magnitude of improvement possible with each of the systems if the present optimization procedure were applied. A good agreement was found between the predicted and the previously reported values for some systems (e.g. Li/CuO), while some other systems showed room for improvement. 14 refs.

2163 SOME OBSERVATIONS ON THE PREDICTION OF THE STATE OF DISCHARGE OF BATTERIES. Kornfeil, F. (Army Electronics Command, Fort Monmouth, NJ). J. Electrochem. Soc.; 123: No. 9, 1271-1276(Sep 1976).

A galvanostatic test method is described to determine the state of discharge of cells of the system Zn/KOH/HgO, and the results are compared with data obtained in loaded voltmeter tests. In a general treatment of battery testing, equations are derived which show, inter alia, that for all electrochemical systems the sensitivity of galvanostatic tests is higher than the sensitivity of the loaded voltmeter method and which allow, e.g., the calculation of the value of the external resistance yielding the maximal sensitivity attainable in a loaded voltmeter test.

2164 PROCESS FOR RECHARGING SECONDARY BATTERIES. Minck, R.W.; Weber, N.; Chang, Y. (to Ford Motor Co.). US Patent 3,976,503. 24 Aug 1976. Filed date 14 Apr 1975. 14p.

An improved process is described for recharging secondary cells or batteries of the type which in the discharged state comprise (a) an anodic reaction zone containing a molten alkali metal reactant-anode in electrical contact with an external circuit; (b) a cathodic reaction zone containing (1) cathodic reactants selected from the group consisting of (i) a single-phase composition comprising molten polysulfide salts of the anodic reactant and (ii) a two-phase composition comprising molten sulfur and molten sulfur-saturated polysulfide salts of the anodic reactant and (2) an electrode of porous, electronically conductive material which is at least partially immersed in the cathodic reactants; and (c) a cation-permeable barrier to mass liquid transfer interposed between and in contact with the anodic and cathodic reaction zones, the porous, electronically conductive material being in electrical contact with both the cation-permeable barrier and an external circuit. The improvement of the invention comprises maintaining a temperature gradient within the cathodic reaction zone during recharging such that the temperature of the cathodic reactants in a first region adjacent the solid electrolyte is sufficiently higher than the temperature of the reactants in a second region not adjacent the solid electrolyte such that sulfur in the first region vaporizes and is transported to the second region, where it condenses. 3 figures.

2165 SERVICE TIPS FROM DETROIT. MAINTENANCE-FREE BATTERY. Janicki, E. Battery Man; 18: No. 8, 14-16(Aug 1976).

Maintenance of the ''Freedom'' battery, which is standard equipment on some 1976 General Motors cars, is discussed for the service station operator. The state-of-charge indicator, testing, and battery charging procedures are considered. (RWR)

2166 UPDATE: MAINTENANCE-FREE BATTERIES. Battery Man; 18: No. 8, 20(Aug 1976).

Performance characteristics of maintenance-free batteries are discussed. The improvements obtained from use of antimony-free calcium--lead alloys are pointed out. (RWR)

2167 BATTERIES KICK OFF NEW MARKETS--1. DRY BATTERIES WITH HIGH ENERGY DENSITY, MINIMAL SELF--DISCHARGE PROMISE SOLID DEMAND FROM ME. Ogawa, H. (Matsushita Electr Ind Co, Osaka, Jpn). JEE (J. Electron. Eng.); No. 116, 35-38(Aug 1976).

Recent advances in science and technology have brought improvements to cardiac pacemakers and great interest is being shown in efforts to lengthen their service life. This article deals with power sources--alkaline primary, lithium, solid electrolytic, rechargeable and nuclear batteries--and trends in their development.

2168 C.G.E. CIRCULATING ZINC/AIR BATTERY: A PRACTICAL VEHICLE POWER SOURCE. Appleby, A.J.; Jacquier, M. (Cent de Rech de La Cie Gen d'Electr, Marcoussis, Fr). J. Power Sources; 1: No. 1, 17-34(Jul 1976).

The currently proposed electric vehicle power sources are briefly summarized, and compared with the circulating zinc/air system. Based on current laboratory test data, this system should be capable of 110 Wh/kg, 80 W/kg in a 1 ton urban vehicle and up to 125 Wh/kg in heavy duty applications, with lifetimes up to twice those for lead-acid systems.

2169 ANODIC BEHAVIOR OF LITHIUM IN AQUEOUS ELECTROLYTES. I. TRANSIENT PASSIVATION. Littauer, E.L.; Tsai, K.C. (Lockheed Missiles and Space Co., Inc., Palo Alto, CA). J. Electrochem. Soc.; 123: No. 6, 771-776(Jun 1976).

Lithium manifests a transient passivation when it is anodically polarized to approximately -2.66 NHE in LiOH electrolytes. The duration of the passivation ranges from seconds to hours. The occurrence of the passivation is independent of electrolyte concentration, flow velocity, anode--cathode contact pressure, and of the polarization technique used. The duration of the transient is proportional to electrolyte concentration; the more dilute the solution, the shorter the time. The passivation is believed due to the formation of an insulating, but unstable, aggregate of $Li_2O$ which nucleates at active Li sites at the base of the pores in the protective LiOH film. The recovery of the surface to the active state is due to the conversion of the $Li_2O$ to LiOH in the presence of water at the Li surface. 6 figures, 1 table.

2170 HIGH ENERGY DENSITY SOLID-STATE BATTERY SYSTEM. Liang, C.C.; Barnette, L.H. (P.R. Mallory and Co., Burlington, MA). J. Electrochem. Soc.; 123: No. 4, 453-458(Apr 1976).

The discharge and storage characteristics of a new solid-state battery system, Li/LiI($Al_2O_3$)/$PbI_2$, PbS, Pb were investigated. Results of the discharge tests suggested that both $PbI_2$ and PbS are cathode active and can be discharged efficiently. A discharge efficiency of 100% was realized on tesst cells with a stoichiometric

capacity of 18 mA-hr/cm² at a drain rate of 10 μA/cm² at room temperature. Results of the storage tests showed that the system is stable on storage. The discharge and storage characteristics indicate that the system is a practical, low rate solid-state battery system and the practical batteries have a volumetric energy density of 8 W-hr/in.³ (0.49 W- hr/cm³) at a power level of 150 μW/in.³. 5 refs.

2171 LITHIUM BATTERIES. Siebert, H.P. Elektronik (Munich); 25: No. 4, 47-50(Apr 1976). (In German).

7 figs.; 5 tabs.; 1 ref..

The article gives a survey of commercial or proposed primary batteries using lithium as anode material. The technical data of cells made by Messrs. Saft, Silberkraft, Matsushita and Tadiran are given.

2172 HYDRODYNAMIC INSTABILITIES IN A LEAD ACID BATTERY. Auerbach, J. (Bator Electrochemical Industry, Tel Aviv, Israel); Gavish, B.; Reich, S. Nature (London); 260: 311-312(25 Mar 1976).

The feasibility of observing hydrodynamic instabilities in a lead--acid battery during discharge is demonstrated. A system comprising two horizontal electrodes immersed in a transparent cell is used. The electrodes contain in the charged state porous $PbO_2$, the ''positive'' electrode, and porous Pb, the ''negative'' electrode. The electrodes were prepared to commercial standards using common industrial processes. A laser is used to observe specific gravity gradients accompanied by parallel gradients in the index of refraction. For current densities exceeding a critical value, the y-direction diffusion processes of acid and of water are incapable of transferring the required flow rates of carriers, and an hydrodynamic instability can be expected. The development of this instability involves the creation of a water layer of low density at the bottom electrode, with a region of high density on top of it. In a gravitational field this inverted distribution of densities is discharged into patterns of ascending water and descending acid. 2 figures.

2173 BATTERIES FOR ELECTROCARS. Phys. Unserer Zeit; 7: No. 2, 33(Mar 1976). (In German).

1 fig.; 1 tab..

A review of the present state of battery technology for electro-automobiles is given. Zinc--chlorine batteries are compared with iron--nickel oxide cells, zinc--chlorine cells, and high-temperature cells of sodium sulfur and lithium/iron sulfide types.

2174 ROLE OF TERNARY PHASES IN CATHODE REACTIONS. Whittingham, M.S. (Exxon Research and Engineering Co., Linden, NJ). J. Electrochem. Soc.; 123: No. 3, 315-320(Mar 1976).

The cell reactions between lithium and several transition metal oxides and sulfides have been found to produce ternary phases and not the formation of lithium oxide or sulfide as previously proposed. These reactions, at 25C, take place with essential retention of the crystalline lattice; secondary cathodic behavior is thus facilitated. It is found that cell reversibility is optimized when no chemical bonds are broken during discharge, that is, where ternary phases are formed by an intercalation reaction and where a broad range of nonstoichiometry exists as in the system Li/$TiS_2$. Where some chemical bonds are broken as for $V_2O_5$ and $TiS_3$ partial or difficult reversibility is found; but when all the bonds are broken, as for example in CuS, the cell exhibites only primary characteristics.

2175 EFFECT OF SILICATE ION ADDITION ON THE DISSOLUTION OF ZINC IN ALKALINE SOLUTION. Armstrong, R.D.; Bell, M.F. (Univ. of Newcastle upon Tyne, Eng.). Electrochim. Acta; 21: No. 2, 155-156(Feb 1976).

It has been reported that the charge necessary for passivation of a zinc/air cell containing approximately 3M potassium hydroxide with the addition of 2 percent v/v potassium silicate solution is infinite, so that complete utilization of the zinc electrode in a power source application can be achieved. It has also been suggested that this phenomenon is due to a silicate-rich layer at the electrode surface, in which the zincate ion is more soluble. Measurements designed to test this hypothesis are reported. In both 3M and 1M KOH, the effect of the addition of silicate ions was to lower the steady-state current at any potential. The Tafel region moved to more anodic potentials; this action reflects the decrease in current. Lack of appreciable change in Tafel slope suggests that the mechanism of dissolution does not depend on the silicate ion. The electrode impedance was measured in 1M KOH as a function of potential and silicate ion concentration. The results show that the effect of silicate ion addition is to inhibit the rate of dissolution of zinc, by adsorption of the silicate ion on the surface. Anomalous continuous dissolution can therefore not be related to surface phenomenon. Viscosity experiments showed that there is only a small change in viscosity on the addition of silicate ions to 3M KOH. This change is too small to be important in the operation of the battery. Apparently, addition of silicate to the electrolyte delays the precipitation of zinc oxide (or hydroxide) from the bulk solution. 3 figures, 1 table. (RWR)

2176 IMPEDANCE OF SILVER OXIDE-ZINC CELLS. Frank, H.A.; Long, W.L.; Uchiyama, A.A. (Jet Propulsion Lab., Pasadena, CA). J. Electrochem. Soc.; 123: No. 1, 1-9(Jan 1976).

Over 100 sealed AgO--Zn cells were subjected to prolonged periods of storage over a range of temperatures and storage modes including open circuit, trickle charge, and float charge. Impedances of these cells were monitored throughout and to the end of the storage period at which point their transient voltage characteristics were observed at the onset of discharge. Results revealed that the impedances of these cells tended to increase with time on stand and that the magnitude of the impedance rise was dependent primarily on temperature and to a lesser degree on storage mode. Typical values for 50 Ah cells were usually less than 100 m ohms at time zero (immediately after activation) and from 1 to 30 ohms after 6 to 10 months of storage. Results provide new and useful information for designers and users of AgO--Zn-based power systems.

2177 POTENTIAL DISTRIBUTION IN LOCAL CELLS ON CORRODING METALS. Ogura, K.; Haruyama, S. (Tokyo Inst. of Tech.). Electrochim. Acta; 21: 59-61(Jan 1976).

In galvanic corrosion, the distribution of potential within the electrolyte was calculated for the condition that each local cell is independent and there is no interaction between the local cells. This analysis of the problem extended Waber's treatment, and the

distribution of potential was obtained for each local cell. 3 figures.

2178 KINETICS AND MECHANISM OF DEPOSITION OF ZINC FROM ZINCATE IN CONCENTRATED ALKALI HYDROXIDE SOLUTIONS. Despic, A.R.; Jovanovic, D.; Rakic, T. (Univ. of Belgrade). Electrochim. Acta; 21: No. 1, 63-77(Jan 1976).

Galvanostatic investigation was carried out of the kinetics of the reaction on zinc amalgam hanging mercury drop immersed in alkaline zincate solutions at KOH concentrations ranging from 1 to 14 normal. Three kinds of data were extracted: (1) the pseudo-capacitance as a function of overpotential from the portion of the charging curves prior to plateaus, (2) the Tafel plots from quasi-steady state values at the plateaus, and (3) the Sand's products as function of current density from transition times. In (1), the pseudo-capacitance was found to increase with overpotential; in (2), two slopes (60 mV $dec^{-1}$ and 120 mV $dec^{-1}$) were found in the cathodic direction, and a limiting current was found in the anodic one; in (3), the Sand's product was found to decrease with increasing (1). On the basis of the above findings the reaction mechanism was suggested to be of the cece type, with the chemical dissociation of the intermediate univalent zinc complex between the two electrochemical steps as rate-determining. A modification of the method of evaluating the reaction orders was introduced to account for a simultaneous change of more than one activity of reactants in concentrated solutions. Reaction order was found to be 2 with respect to both $OH^-$ ions and water, this result suggesting that the electroactive species is not only reduced in the number of ligands but also dehydrated with respect to the prevailing species. The anodic limiting current appears to be due to the accumulation of Zn(OH) species to cover all the surface free of adsorbed $Zn(OH)_2$. Exchange c.d. and rate constants of all the four steps of the reaction were estimated. 13 figures, 2 tables.

2179 PROBLEM OF A SYSTEM OF JETS MIXING IN A TRANSVERSE RESTRICTED FLOW. Spiridonov, Yu.A.; Izotov, E.P. Teploenergetika (Moscow); No. 1, 14-17(Jan 1976). (In German).

Results are presented of an experimental investigation of the dependence of the nonuniformity of the temperature field of the mixture on the relative value of jet impulses, the distance between the apertures in the zone, and the diameter of the aperture. Practical recommendations are presented on the design and adjustment of devices permitting considerable increase of the coefficient of hydraulic resistance and of the mixing chambers working within a wide range of variation of refine parameters.

2180 DRY--CHARGING NICKEL-CADMIUM ACCUMULATOR. Romanov, V.V.; Sandler, P.I. Zh. Prikl. Khim.; 49: No. 1, 242(Jan 1976). (In Russian).

Deposited article; for English translation see the journal J. Appl. Chem. USSR.

CADMIUM;CHEMICAL PREPARATION;COMPARATIVE EVALUATIONS;ELECTRIC BATTERIES;NICKEL;OXIDATION; REDUCTION;NICKEL-CADMIUM BATTERIES;BATTERY CHARGING

2181 INVESTIGATION OF LITHIUM--THIONYL CHLORIDE BATTERIES FOR NAVY APPLICATIONS. McCartney, J.F.; Shipman, W.H.; Gundersen, C.R. (Naval Undersea Center, San Diego, CA). pp 457-461 of Eleventh intersociety energy conversion engineering conference. Vol. I. New York; American Institute of Chemical Engineers (1976).

From 11. intersociety energy conversion engineering conference; State Line, Nevada, USA (12 Sep 1976).

See CONF-760906--P1.

The Naval Undersea Center (NUC) recently performed an extensive test program with low-rate and high-rate lithium--thionyl chloride ($SOCl_2$) cells. This program aided in identifying capabilities and deficiencies with the present technology. Many deficiencies were readily corrected, but others are less understood and additional development is required. As a result of this program, improved, low-discharge rate, hermetically sealed calls and batteries are being used in several ocean-oriented applications. Future development programs are planned to provide safe, high discharge rate cells for propulsion and pulse-power applications. 5 figures, 3 tables.

2182 APPLICATION OF NICKEL--CADMIUM BATTERIES IN DEEP DISCHARGE SYNCHRONOUS ORBIT APPLICATIONS. Sparks, R.H.; Scott, W.R. (TRW Defense and Space Systems Group, Redondo Beach, CA). pp 517-520 of Eleventh intersociety energy conversion engineering conference. Vol. I. New York; American Institute of Chemical Engineers (1976).

From 11. intersociety energy conversion engineering conference; State Line, Nevada, USA (12 Sep 1976).

See CONF-760906--P1.

The nickel--cadmium battery has had success in spacecraft for mission durations in excess of five years when operated at a depth of discharge of up to 50 percent of rated capacity. Recent development work has demonstrated that operation at deeper depths of discharge is feasible. Lifetimes of at least seven years at a depth of discharge of 85 percent and over ten years at a depth of discharge of 75 percent have been demonstrated. The techniques required for deep-cycle service operation include using full discharge reconditioning to a low battery voltage (on the order of 1.0 volt total battery voltage), restricting operating temperature to less than 15°C on charge, maintaining charge rates above C/15 at end of life, and minimizing energy input during sunlight standby periods. Deep discharge reconditioning is shown to be the key to successful deep depth of discharge operation, and is instrumental in maintaining battery voltage regulation and capacity retention. 9 figures.

2183 NICKEL--CADMIUM CELL COMPOSITE RELIABILITY MODEL. Kirsch, W.W. (Sperry Rand Corp., Huntsville, AL); Paschal, L.E. pp 521-527 of Eleventh intersociety energy conversion engineering conference. Vol. I. New York; American Institute of Chemical Engineers (1976).

From 11. intersociety energy conversion engineering conference; State Line, Nevada, USA (12 Sep 1976).

See CONF-760906--P1.

Ni--Cd battery reliability has become a critical design parameter with the increasing need for longer life and optimally designed secondary battery power systems in space as well as in more mundane applications. This paper presents a state-of-the-art Ni--Cd cell reliability model as a function of cumulative cyclic operation, cell temperature, and cyclic depth-of-discharge. In addition, a simple and convenient cell failure analysis technique will be presented in which the reliability, the distribution, and the distribution parameters

can be determined by visual inspection. 9 figures, 2 tables.

2184 JAPANESE LEAD--ACID BATTERIES: NEW TECHNOLOGY AND RECENT PRODUCTS. Kozawa, A.; Takagaki, T. (Office of the Electrochemical Society of Japan, Cleveland). pp 532-536 of Eleventh intersociety energy conversion engineering conference. Vol. I. New York; American Institute of Chemical Engineers (1976).

From 11. intersociety energy conversion engineering conference; State Line, Nevada, USA (12 Sep 1976).

See CONF-760906--P1.

New technology of Japanese automobile batteries, electric-vehicle batteries and stationary batteries, which are being produced today is summarized. Particularly, a great deal of progress was made in automobile batteries wand electric-vehicle batteries in 1975. The performance of the batteries and the background of such a development are given. 16 figures, 5 tables.

2185 EXPERIENCE IN ESTIMATING THE RELIABILITY OF POWER SUPPLY SYSTEMS USING RENEWABLE SOURCES OF ENERGY BY MEANS OF BIMODAL DISTRIBUTION CURVES. Saliyeva, R.B. (Tashkent Electric Engineering Inst.). Geliotekhnika; No. 4, 57-62(1976). (In Russian).

A study is made of the mathematical description of the distribution function of the duration of the period of operation of an electric battery by means of a bimodal curve. The distribution function characterizes the distribution of the length of continuous functioning of the apparatus controlling the operation of the electric battery. This is important because 90 to 95 percent of the power consumed is provided by wind or solar power plants in combination with electric batteries.

2186 SELECTION OF A POWER SUPPLY FOR ELECTRIC HEART STIMULATORS AND STUDY OF THE CHARACTERISTICS OF THE ''KRONA VTS'' BATTERY. Dubrovskii, I.A.; Ostashkin, S.P. (Moscow Inst of Phys Eng, USSR). Biomed. Eng. (USSR) (Engl. Transl.); 10: No. 2, 85-87(1976).

This paper tabulates the basic parameters of what are said to be the most popular dry and storage batteries in the USSR for use as power sources for portable prosthetic and auxiliary apparatus. The ''Krona VTs'' air-zinc battery, which has the highest specific energy by volume (322 mwhr/cm$^3$) and the lowest weight (40g), except for the KRs-55s cell which is presently unavailable, is indicated as the most suitable for this service. Experimental discharge curves for the ''Krona VTs'' are shown, and the data are analyzed to explain its suitability for operation in a pulse mode. It is concluded that the ''Krona VTs'' battery can be successfully used as a source for an independent supply on external electric heart stimulators as well as on auxiliary cardiostimulating and other medical apparatus that functions in a pulse mode with a high duty factor, and it will provide a substantial period of continuous operation from one battery.

2187 ELECTRIC POWER SYSTEMS FOR SPACE: A PROGRESS REPORT. Turner, G.F. Astronaut. Aeronaut.; 13: No. 12, 18-29(Dec 1975).

SPACECRAFT POWER SUPPLIES;REVIEWS;SILICON SOLAR CELLS;SOLAR CELL ARRAYS;OPERATION;POWER CONDITIONING CIRCUITS;RADIOISOTOPE HEAT SOURCES; THERMOELECTRIC GENERATORS;FUEL CELLS;ENERGY STORAGE;RESEARCH PROGRAMS;THERMODYNAMIC CYCLES; SATELLITES;NICKEL-CADMIUM BATTERIES;PERFORMANCE; NICKEL-HYDROGEN BATTERIES;REGENERATIVE FUEL CELLS;HYDROGEN FUEL CELLS

2188 GIBBS--HELMHOLTZ EQUATION AND THE EMF OF GALVANIC CELLS. I. INAPPLICABILITY TO LIQUID--LIQUID JUNCTION POTENTIALS. Brenner, A. (N-Q Electrochemical Research Corp., Reston, VA). J. Electrochem. Soc.; 122: No. 12, 1602-1609(Dec 1975).

Measurements were made of the temperature coefficient of the emf of a type of concentration cell in which the emf was generated solely by liquid--liquid junctions. The data fit the Henderson equation very well but not the Gibbs--Helmholtz equation. The discrepancy between the values of $\Delta H$, computed from the Gibbs--Helmholtz equation, and the values measured calorimetrically is shown to be calculable from ionic mobilities. In addition, data are presented showing that the sum of the thermoelectric powers of the three junctions (including a liquid--liquid junction) is equal to the isothermal temperature coefficient of the emf of the cell. 4 figures, 4 tables.

2189 GIBBS--HELMHOLTZ EQUATION AND THE EMF OF GALVANIC CELLS. II. PRECISION OF ITS APPLICATION TO CONCENTRATION CELLS. Brenner, A. (N-Q Electrochemical Research Corp., Reston, VA). J. Electrochem. Soc.; 122: No. 12, 1609-1615(Dec 1975).

The Gibbs-Helmholtz equation is usually tested by comparing the enthalpy, $\Delta H/\text{sub emf}/$, of the cell reaction obtained by means of the equation with the calorimetrically determined enthalpy, $\Delta H/\text{sub cal}/$. A survey was made of three such tests in the literature. An examination of the precision of the correspondence between $\Delta H/\text{sub emf}/$ and $\Delta H/\text{sub cal}/$ was made using concentration cells without transference, containing either hydrochloric or sulfuric acid. The enthalpy change was a partial molal heat of dilution. With dilute solutions of hydrochloric acid the agreement was satisfactory. With strong solutions of hydrochloric and of sulfuric acid the difference amounted to a hundred calories or more. In sulfuric acid concentration cells with transference the difference amounted to several hundred calories. The differences for these cells are shown to be due mainly to the variation of the transference number of the hydrogen ion with temperature. On this basis, the discrepancy of the Gibbs--Helmholtz equation is easily calculated. 9 tables.

2190 NICD AND LEAD ACID D-SIZE CELLS MEET IN THE RECHARGEABLE ARENA. Prod. Eng. (N.Y.); 46: No. 11, 22-23(Nov 1975).

Sealed nickel--cadmium miniature cells have pretty much monopolized the rechargeable applications in portable calculators, tape recorders, radios, TV, hand tools, and the like. Rechargeable dry cells (manganese alkaline) and miniature lead--acid batteries have not been able in the past to challenge the NiCd cells in too many major applications. However, there is a recent surge of interest in lead--acid D-cells (and X-cells). Lead acid batteries are a natural choice for economical power because the materials of construction cost less than the nickel, cadmium, and silver in competitive designs. Respective advantages of these two battery types are discussed and their performance is compared.

2191 ZINC--HALIDE BATTERY WITH MOLTEN ELECTROLYTE. England, C. (to California Inst. of Tech.). US Patent 3,912,999. 14 Oct 1975. Filed date 11 Jul 1973. 6p.

Dendrite growth on Zn anodes is a continuing problem in battery use. The growth of dendrites during charging can be prevented or controlled by operating the battery (at least part of the time) at a temperature above the melting point of zinc, or at least at such a temperature that forming dendrites are melted by the heat generated by the charging current. For the case of a large number of cells, the halogen gas produced during charging can be compressed and liquefied for storage; much of the energy used therefor is recovered in gas expansion during battery use. (RWR)

2192 HOW TO GET LONGER LIFE FROM MOTIVE POWER BATTERIES. (C and D Batteries, an Eltra company, Plymouth Meeting, PA). Coal Age; 80: No. 11, 162-5(Oct 1975).
ELECTRIC-POWERED VEHICLES;ELECTRIC BATTERIES; OPERATION;USES;PERFORMANCE;BATTERY CHARGING; MAINTENANCE

2193 THIN FILM GALVANIC CELL WITH $RBAG_4I_5$ SOLID ELECTROLYTE. Bodnaruk, L.I.; Danilov, A.V.; Kulinkovich, V.E.; Aleskovskii, V.B. (Leningradskij Tekhnologicheskij Inst. (USSR)). Elektrokhimiya; 11: No. 9, 1325-1327(Sep 1975). (In Russian).
For English translation see the journal Sov. Electrochem..
In order to decrease the size and weight and to increase the specific capacity and energy of galvanic cells, some solid electrolytes in the form of thin films are proposed. The galvanic cells were prepared by a combined method: the cathodic and anodic materials (Te and Ag) were evaporated under vacuum to cover an electrolyte layer, the latter being obtained by impregnating the porous materials with $RbAg_4I_5$ acetonic solution. The most specific charge curves of the galvanic cells at various current densities are given: specific energy of the samples was 0.2 to 0.7 watt-h/kg, their capacity being 0.1 to 0.2 mAh. Behavior of the cells when stored (that of the $Ag(RbAg_4I_5)$ interface in particular) was investigated, namely, the effect of the storage time on the capacity and internal resistance of the galvanic cell.

2194 REGENERATION OF ELECTRIC CELLS WITH SOLID ELECTROLYTES. Kolomyitsev, V.P.; Murzin, G.M.; Orekhova, E.A.; Podrugin, D.P.; Filimonov, V.V. USSR Patent 480,969. 15 Aug 1975. Filed date 26 Apr 1973.
METAL-METAL BATTERIES;REGENERATION; ELECTROLYTES;SOLIDS;PLATINUM;CHLORIDES;AQUEOUS SOLUTIONS

2195 APPARATUS AND METHOD FOR SEPARATING THE CONSTITUENTS OF LEAD--ACID STORAGE BATTERIES. La Point, A.E. US Patent 3,892,563. 1 Jul 1975. Filed date 14 May 1973. 10p.
A process for reclaiming active constituents of discarded lead--acid batteries is described. Shredded batteries, along with sodium carbonate and water, are directed into a rotating drum separator. After agitation and break-up, the battery constituents are separated, organic material floating in the slurry being removed, the heavier particles sinking to the bottom. These particles are then further separated by size by use of screens. (RWR)

2196 OBTAINING CRUDE LEAD FROM MATERIALS CONSISTING ESSENTIALLY OF OXIDES AND SULFIDES. Petersson, S.A.; Lundquist, S.A. (to Boliden AB). German(FRG) Patent 2,459,832. 26 Jun 1975. Filed date 20 Dec 1973. 17p.
LEAD-ACID BATTERIES;LEAD;RECOVERY;WASTES; WASTE PROCESSING;GRIDS;LEAD OXIDES;LEAD SULFIDES;LEAD SULFATES;MELTING;REDUCTION

2197 BATTERIES POWER URBAN AUTOS. Cairns, E.J.; McBreen, J. (General Motors Research Lab., Warren, MI). Ind. Res.; 17: No. 6, 56-60(Jun 1975).
R and D achievements are reviewed, and high temperature cells using lithium are evaluated. Equations, tables, and graphs illustrate data.

2198 MAINTENANCE-FREE LEAD--ACID BATTERIES. Dailbard, G.; Atkins, J.; Pothet, J.; Viaud, N. Rev. Gen. Electr.; 84: No. 6, 463-472(Jun 1975). (In French).
The various aspects of maintenance-free lead--acid batteries are described: self-discharge, water consumption, gas tightness. For the positive electrode, after having specified active material composition, the authors study the influence of the proportion of lead dioxide present on the kinetics of self-discharge, as well as the degradation of the active material--grid contact as a function of the alloy used. They show that the self-discharge kinetics of the negative electrode is closely linked to that of the positive by the oxygen liberated and, for certain alloys, the presence of antimony ions. Water consumption can be reduced by increasing the hydrogen overvoltage, which leads to the use of special alloys with little or no antimony. It is possible, by using an appropriate separator, to facilitate oxygen transfer to the negative and thus its reduction. The efficiency can be made 100% by increasing the cell internal pressure and using a limited quantity of electrolyte. Finally, the recombination of hydrogen and oxygen by catalysis is also mentioned.

2199 APPARATUS AND METHOD FOR PRODUCING RECHARGEABLE ZINC ELECTRODES. Mueller, J. (to Deutsche Automobilgesellschaft mbH). German(FRG) Patent 2,353,926. 28 May 1975. Filed date 27 Oct 1973. 10p.
Patent; Raney Ni or NiO aux. electrode for occasional additional discharge results in improved cycle life. NICKEL-ZINC BATTERIES; DESIGN;NICKEL OXIDES;ELECTRODES;LIFETIME

2200 LEAD STORAGE BATTERY. Ziegler, S.; Seiboth, W. (to Bosch, Robert, GmbH). German(FRG) Patent 2,356,212. 28 May 1975. Filed date 10 Nov 1973. 6p.
Patent; addition of Tl sulfates. LEAD-ACID BATTERIES;PERFORMANCE;ADDITIVES;THALLIUM SULFATES;ELECTROLYTES;ELECTRODES;GRIDS

2201 BATTERY TECHNOLOGY. PACKAGING MORE MUSCLE INTO LESS SPACE. Lyman, J. Electronics; 48: No. 7, 75-82(3 Apr 1975).
The appeal of low-power electronic equipment is being enhanced by new primary and secondary cells, which perform better and are packaged more simply than older power sources. New primary and secondary cells made of lithium, zinc chloride, divalent silver oxide, silver--cadmium, and silver--zinc, as well as gelled and 'starved' lead--acid, electrochemicals provide more power per pound, longer shelf life, higher performance over a longer temperature range, and better packaging. Inexpensive primary batteries suffice for many small electronic products, such as portable radios, calculators, and watches. However, at higher prices, rechargeable batteries eliminate the inconvenience of battery changing or provide reliable standby power for equipment,

such as volatile computer memories, which would otherwise lose their effectiveness if the line power failed.

2202 IMPROVEMENT OF LEAD--ACID BATTERY MAINTENANCE. Kawamoto, H.; Shimodaira, A. (Nippon Telegraph and Telephone Public Corp., Tokyo). Jpn. Telecommun. Rev.; 17: No. 2, 140-146(Apr 1975).
Theoretical and experimental investigations of the optimum floating voltage of lead--acid batteries, a new maintenance method abolishing equalizing charges, and a field test are discussed. The new maintenance method is now applied to small-capacity exchange offices, and a great saving of labor is realized.

2203 LITHIUM-TITANIUM DISULFIDE SECONDARY BATTERY. Whittingham, M.S. (to Exxon Research and Engineering Co.). GE 2,442,411. 13 Mar 1975. Filed date 10 Sep 1973. 16p.
Saturated $LiPF_6$--propylene carbonate electrolyte;patent. LITHIUM;TITANIUM SULFIDES; CARBONIC ACID DERIVATIVES;LITHIUM FLUORIDES; PHOSPHORUS FLUORIDES;ELECTRIC CURRENTS;LITHIUM-SULFUR BATTERIES;METAL-NONMETAL BATTERIES

2204 KILOWATTHOURS VS. LITERS: GAS BUGGIES MAY BE ON THE ROPES BY THE EIGHTIES IF 'SUPER BATTERIES' ARRIVE ON SCHEDULE. Salihi, J.T. IEEE Spectrum; 12: No. 3, 62-66(Mar 1975).
Electric- and gasoline-powered autos. URBAN AREAS;ELECTRIC-POWERED VEHICLES;LEAD-ACID BATTERIES;ELECTRIC BATTERIES;TRANSPORTATION SYSTEMS;ENERGY CONSUMPTION;GASOLINE;COMPARATIVE EVALUATIONS;EFFICIENCY;AUTOMOBILES;PERFORMANCE TESTING

2205 METHOD FOR MEASUREMENT OF THE CHARGE STATE OF GALVANIC ENERGY SOURCES AND EQUIPMENT FOR USING THIS METHOD. Bader, C. (to Deutsche Automobilgesellschaft m.b.H.). German(FRG) Patent 2,242,510/B/. 13 Feb 1975. 4p. (In German).
1 fig. Available from Dt. Patentamt, Muenchen (FRG).
Various possibilities for measuring the charge state of galvanic energy sources are discussed and compared with each other. An electronic circuit containing an operation amplifier is used as voltage comparator, and to the amplifier are fed a voltage proportional to the admissible gasing voltage and a voltage proportional to the actual battery voltage, both voltage being compared with each other in the amplifier.

2206 RECHARGING OF METAL--AIR BATTERIES. Andrew, M.R. (to Shell Internationale Research Maatschappij BV). British Patent 1,382,025. 29 Jan 1975. Priority date 15 Oct 1970, Netherlands. 8p.
In the type of battery discussed, the air electrode can be isolated during recharge. The internal arrangement includes a three-way tap which permits the air flow to be directed around the electrode. (RWR)

2207 STORAGE BATTERY. (to Aktiebolag Tudor). Australian Patent 320,045. 27 Jan 1975. Filed date 05 Jan 1972. 7p.
Patent; leakproof battery. ELECTRIC BATTERIES;DESIGN

2208 RECOVERY OF ZINC AND POTASSIUM HYDROXIDE FROM SPENT ELECTROLYTES. Lemaire, G. (to Societe des Accumulateurs Fixes et de Traction). German(FRG) Patent 2,428,062. 16 Jan 1975. Filed date 26 Jun 1973. 8p.
ZINC-AIR BATTERIES;ELECTROLYTES;ZINC; POTASSIUM HYDROXIDES;RECOVERY;WASTE PROCESSING; METHANOL

2209 SEALED NICKEL--HYDROGEN SECONDARY CELL. Giner, J.; Dunlop, J.D. (Tyco Lab., Waltham, MA). J. Electrochem. Soc.; 122: No. 1, 4-11(Jan 1975).
50 Ah, 28 Wh/lb. NICKEL-HYDROGEN BATTERIES; SEALS;PERFORMANCE;SATELLITES;LOW TEMPERATURE

2210 SEALED NICKEL--HYDROGEN SECONDARY CELL. Giner, J.; Dunlop, J.D. (Tyco Lab., Waltham, MA). J. Electrochem. Soc.; 122: No. 1, 4-11(Jan 1975).
A recently developed sealed nickel-hydrogen cell offers considerable promise to develop lightweight, long-life, rechargeable batteries. The most apparent advantages of this cell are its higher energy and power density as compared with other rechargeable systems including nickel-cadmium, lead-acid, and silver-zinc cells and the regenerative $H_2$--$O_2$ fuel cell. The energy density for lightweight 50 A-hr cells shown in 28 W-hr/lb. The cell enjoys a unique overdischarge protection mechanism which allows for long cycle life at high depth of discharge. Experimental data are presented to define the characteristics of the cell. Over 5000 high rate cycles have been completed on small 1.5 A-hr cells with good voltage performance. A 50 A-hr cell has completed to date over 800 cycles discharge to 70 percent of measured capacity in 1.2 hr. The specific application of this system is to synchronous satellite operation. It also promises attractive low-temperature performance. 3 references.

2211 ACCELERATED LIFE TESTING OF LEAD--ACID INDUSTRIAL MOTIVE POWER CELLS. Maskalick, N.J. (Westinghouse Res. Lab., Pittsburgh, PA). J. Electrochem. Soc.; 122: No. 1, 19-25(1975).
LEAD-ACID BATTERIES;GRIDS;CORROSION; DECOMPOSITION;LIFETIME;PERFORMANCE TESTING;LEAD BASE ALLOYS;ANTIMONY ALLOYS;MEDIUM TEMPERATURE; FORECASTING

2212 VOLTAGE DROP IN DISCHARGES OF LEAD STORAGE BATTERIES. Euler, K.J. (Gesamthochsch. Kassel, Kassel, Germany). Naturwissenschaften; 62: No. 5, 235-6(1975).
LEAD-ACID BATTERIES;ELECTRIC POTENTIAL; CATHODES;ELECTRIC CONDUCTIVITY

2213 EVOLUTIONARY DEVELOPMENTS IN NICKEL--ZINC CELL TECHNOLOGY. Charkey, A. (Energy Research Corp., Danbury, CT). pp 1126-1130 of Tenth intersociety energy conversion engineering conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1975).
From 10. intersociety energy conversion engineering conference; Newark, Delaware, USA (17 Aug 1975).
See CONF-750812--.
NICKEL-ZINC BATTERIES;ELECTRODES;BATTERY SEPARATORS;FABRICATION;PERFORMANCE

2214 CASE FOR LEAD--ACID STORAGE BATTERY PEAKING SYSTEMS. Maskalick, N.J.; Brown, J.T.; Monito, G.A. pp 1135-1140 of Tenth intersociety energy conversion engineering conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1975).

From 10. intersociety energy conversion engineering conference; Newark, Delaware, USA (17 Aug 1975).
See CONF-750812--.
LEAD-ACID BATTERIES;ECONOMICS;OFF-PEAK ENERGY STORAGE;PERFORMANCE;COST

2215 NICD BATTERY RELIABILITY FOR SHUTTLE-SERVICED SPACECRAFT. Eliason, J. (Sperry Support Services, Huntsville, AL). Contract NAS8-21812. pp 1297-1306 of Tenth intersociety energy conversion engineering conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1975).
From 10. intersociety energy conversion engineering conference; Newark, Delaware, USA (17 Aug 1975).
See CONF-750812--.
empirical model. NICKEL-CADMIUM BATTERIES; RELIABILITY;SATELLITES;SPACE VEHICLES;LIFETIME; FAILURES;MATHEMATICAL MODELS;PERFORMANCE; TESTING

2216 SELECTION OF POWER SOURCES FOR REMOTE OCEAN ORIENTED APPLICATIONS. McCartney, J.F.; Cates, M.A. (Naval Undersea Center, San Diego, CA). pp 1318-1327 of Tenth intersociety energy conversion engineering conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1975).
From 10. intersociety energy conversion engineering conference; Newark, Delaware, USA (17 Aug 1975).
See CONF-750812--.
SHIPS;POWER SUPPLIES;PLANNING;COST;SIZE; WEIGHT;PERFORMANCE;COMPARATIVE EVALUATIONS; ELECTRIC BATTERIES;THERMOELECTRIC GENERATORS; RADIOISOTOPE BATTERIES;SOLAR CELLS;FUEL CELLS; WIND POWER

2217 METAL--AIR SYSTEMS AS SOURCES OF ELECTRIC CURRENT. Jindra, J.; Mrha, J.; Musilova, M. (Ustav Fyz. Chem. Elektrochem. J. Heyrovskeho, Cesk. Akad. Ved, Prague, Czech.). Chem. Prum.; 25: No. 7, 353-7(1975).
Al, Mg, Zn anode corrosion. METAL-GAS BATTERIES;AIR;ALUMINIUM;MAGNESIUM;ZINC; ELECTROCHEMISTRY;ANODES;CORROSION;SODIUM CHLORIDES;POTASSIUM HYDROXIDES;ZINC OXIDES; MERCURY OXIDES;POTASSIUM IODIDES

2218 CALCULATING THE CHARACTERISTICS OF A SILVER--CADMIUM STORAGE BATTERY. Ardabatskii, V.P. Sb. Rab. Khim. Istochnikam Toka; 10: 299-305(1975).
Application to other batteries. SILVER-CADMIUM BATTERIES;ELECTRIC POTENTIAL;ELECTRIC BATTERIES;ELECTRICAL PROPERTIES

2219 HEAT RELEASE IN THE OPERATION OF HERMETIC NICKEL--CADMIUM STORAGE BATTERIES. Ardabatskaya, M.V.; Ten'kovtsev, V.V. Sb. Rad. Khim. Istochnikam Toka; 10: 190-8(1975).
Heat absorbed during charging. HEATING; OPERATION;NICKEL-CADMIUM BATTERIES;BATTERY CHARGING

2220 USE OF ELECTROCHEMICAL DEVICES FOR CONTROL AND MONITORING OF CHEMICAL CURRENT SOURCES. Tsenter, B.I. Sb. Rab. Khim. Istochnikam Toka; 10: 184-90(1975).
CONTROL;PERFORMANCE;ELECTRIC BATTERIES; MONITORING;VOLTMETERS;GASES;ABSORPTION; EQUIPMENT

2221 SELF-DISCHARGE OF SILVER--CADMIUM STORAGE BATTERIES. Neuvorueva, E.M. Sb. Rab. Khim. Istochnikam Toka; 10: 342-50(1975).
Especially during storage at elevated temperature. SILVER-CADMIUM BATTERIES; PERFORMANCE;PHASE DIAGRAMS;SILVER OXIDES; CATHODES;STORAGE;HIGH TEMPERATURE;CHEMICAL REACTIONS;ELECTRODES;STABILIZATION;ANODES; SODIUM COMPOUNDS;SULFONATES;LIGNIN;LUBRICANTS; FUEL OILS

2222 EFFECT OF SILICATE ADDITIVES ON THE ELECTRICAL AND OPERATIONAL CHARACTERISTICS OF SILVER--CADMIUM STORAGE BATTERIES. Alekseeva, N.I.; Razumeeva, M.V.; Berkman, E.A.; Ivanov, E.G.; Nikol'skii, V.A. Sb. Rab. Khim. Istochnikam Toka; 10: 328-34(1975).
SILVER-CADMIUM BATTERIES;OPERATION; ELECTRICAL PROPERTIES;SODIUM SILICATES; ADDITIVES;SILICA GEL;SILICON;PERFORMANCE; CATHODES;PHASE DIAGRAMS;SILVER;QUANTITY RATIO; BATTERY SEPARATORS;STORAGE

2223 SELF-DISCHARGE KINETICS OF SILVER--CADMIUM STORAGE BATTERIES. Alekseeva, N.I.; Berkman, E.A.; Ivanova, R.P. Sb. Rab. Khim. Istochnikam Toka; 10: 334-42(1975).
SILVER-CADMIUM BATTERIES;CHEMICAL REACTION KINETICS;PERFORMANCE

2224 FAST CHARGING LEAD STORAGE BATTERIES. Vidojkovic, V.; Popov, K.; Rakin, P.; Vojnovic, M.; Vracar, L. (Fac. Technol. Metall., Univ. Belgrade, Belgrade, Yugoslavia). Hem. Ind.; 29: No. 9, 401-5(1975).
Evaluated mathematical model for cathode. LEAD-ACID BATTERIES;BATTERY CHARGING;CATHODES; MATHEMATICAL MODELS

2225 PERFORMANCE AND APPLICATIONS OF REVERSIBLE ZINC--AIR AND ZINC/OXYGEN GENERATORS. Vignaud, R. (Cent. Rech., Piles Wonder, St.-Ouen, France). Rev. Gen. Electr.; 84: No. 6, 481-4(1975).
ZINC-AIR BATTERIES;PERFORMANCE;USES

2226 NICKEL--CADMIUM CELL RELIABILITY. Putois, F. (Serv. Etud., Soc. Accumulateurs Fixes et Traction, Romainville, France). Rev. Gen. Electr.; 84: No. 6, 473-80(1975).
NICKEL-CADMIUM BATTERIES;RELIABILITY; FAILURES

2227 ABNORMAL BEHAVIORS OF SOME HYDROCHLORIC ACID ELECTROCHEMICAL SYSTEMS. Lin, Tzu-Fang. (Dep. Chem. Eng., Tatung Inst. Technol., Taipei, Taiwan). J. Chin. Inst. Chem. Eng.; 6: No. 1, 71-5(1975).
Cu/HCl/Pt. METAL-METAL BATTERIES;COPPER; PLATINUM;HYDROCHLORIC ACID;ELECTRIC POTENTIAL

2228 TEXTURE OF A ZINC OXIDE RESIDUE FORMED DURING THE ANODIC OXIDATION OF POROUS ZINC IN AN ALKALINE SOLUTION. Kagan, A.S.; Rogozkina, I.G.; Mandzheritskii, E.A.; Dmitrieva, A.K.; Fadeeva, V.I. Vestn. Mosk. Univ., Ser. II. Khim.; 16: No. 2, 251(1975).
ANODES;ZINC;ZINC OXIDES;TEXTURE;SYNTHESIS; OXIDATION;HYDROXIDES;ELECTROCHEMISTRY;SILVER-ZINC BATTERIES;NICKEL-ZINC BATTERIES;ZINC-MANGANESE BATTERIES;ELECTRIC BATTERIES; ELECTRODES

2229 TRANSPORT PROCESSES IN POROUS ELECTRODES. Winsel, A. (VARTA Batterie AG Forsch.- und Entwicklungszent., Kelkheim, Germany). Ber. Bunsenges. Phys. Chem.; 79:

No. 9, 827-36(1975).
MASS TRANSFER;ELECTRODES;FUEL CELLS;ELECTRIC BATTERIES;DIFFUSION;CHEMICAL REACTION KINETICS; LEAD-ACID BATTERIES;LEAD IONS;LEAD SULFATES

2230 ACTION OF ULTRASOUND ON NICKEL--CADMIUM STORAGE BATTERIES. Mihu, V.P.; Gavrila, I. (Univ. Bucharest, Bucharest, Romania). An. Univ Bucuresti, Stiint. Nat.; 23: 29-34(1975).
NICKEL-CADMIUM BATTERIES;ULTRASONIC WAVES; ELECTROLYTES;ELECTRIC CURRENTS;BATTERY CHARGING; CHEMICAL REACTIONS

2231 OPTIMIZING OF A ZINC/POTASSIUM HYDROXIDE/ OXYGEN CELL WITH A SILVER CATHODE. Solacolu, I.; Mavrodin-Tarabic, M.; Onaca, I. (Cent. Phys. Chem., Bucharest, Romania). J. Appl. Electrochem.; 5: No. 4, 299-303(1975).
300 to 600 mm O overpressure, 20° to 70°, 2 to 7 N concentration. ZINC-AIR BATTERIES; POTASSIUM HYDROXIDES;OXYGEN;OPTIMIZATION;SILVER; CATHODES;PRESSURE DEPENDENCE;TEMPERATURE DEPENDENCE;PERFORMANCE;MEDIUM PRESSURE;MEDIUM TEMPERATURE;QUANTITY RATIO

2232 STABILIZATION OF THE CAPACITY OF A SILVER--CADMIUM BATTERY DURING PROLONGED CYCLING BY ADDING MAGNESIUM OXIDE TO THE SILVER ELECTRODE. Levina, G.A. Sb. Rab. Khim. Istochnikam Toka; 9: 151-5(1975).
SILVER-CADMIUM BATTERIES;STABILIZATION; MAGNESIUM OXIDES;ADDITIVES;CATHODES;EFFICIENCY; PERFORMANCE

2233 REASONS FOR CHANGES IN THE CHARACTERISTICS OF HERMETIC NICKEL--CADMIUM STORAGE BATTERIES UNDER LONG-TERM OPERATION. Boldin, R.V.; Akbulatova, A.D.; Karpova, F.F. Sb. Rab. Khim. Istochnikam Toka; 10: 177-84(1975).
Formation of $Cd_{21}Ni_5$ in anode, gas adsorption rate instability, shorting, case corrosion. SEALS;NICKEL-CADMIUM BATTERIES; OPERATION;ANODES;ADSORPTION;GASES;CONTAINERS; CORROSION;PERFORMANCE

2234 CREATION OF A STANDBY CURRENT SOURCE USING A COPPER--SULFURIC ACID--LEAD(IV) OXIDE GALVANIC SYSTEM. Rusin, A.I.; Yudilevich, S.R.; Nikol'skii, V.A.; Bashin, A.P. Sb. Rab. Khim. Istochnikam Toka; 10: 110-15(1975).
24 Wh/kg, 44 Wh/dm³. METAL-METAL OXIDE BATTERIES;LEAD-ACID BATTERIES;COPPER;SULFURIC ACID;LEAD COMPOUNDS;PEROXIDES;ENERGY; ELECTROLYTES;DENSITY

2235 CHARGE OF THE CADMIUM ELECTRODE OF A CURRENT SOURCE HAVING AN ALKALINE ELECTROLYTE. Andreeva, G.P.; Nikol'skii, V.A.; Papazova, E.I. Sb. Rab. Khim. Istochnikam Toka; 10: 292-9(1975).
Recommended current density, temperature, additives. SILVER-CADMIUM BATTERIES;BATTERY CHARGING;ANODES;HYDROXIDES;CURRENT DENSITY; ADDITIVES;RECOMMENDATIONS

2236 ELECTROCHEMICAL INVESTIGATIONS ON IRON/ ZINC LOCAL CELLS. Beck, F.; Kaiser, H. (BSAG, AG, Ludwigshafen, Ger.). Metalloberflaeche; 29: No. 6, 281-286(1975). (In German).
The magnitude of the local current and the potential profile at the local cells were measured. Current--potential curves were plotted and corrosion tests were performed. Corrosion can be prevented through damping of the local cells by phosphating the Fe and/or the Zn. Local current activity can be varied by factors of about 100 by modification of the Zn side of the cell. (RWR)

2237 THERMODYNAMICS OF A REVERSIBLE GALVANIC CELL. Belorusets, M.M. (Inst. Giproniipoligraf, Moscow). Elektrokhimiya; 11: No. 6, 940-942(1975). (In Russian).
A formula for calculating the voltage, V, of a reversible galvanic element was obtained from the Gibbs--Helmholtz equations. V was shown to be directly proportional to the absolute temperature, T; the temperature coefficient of the element was constant. The element was considered from the point of view of a heat engine obeying the Carnot cycle. Analytical V--T dependences were found for several galvanic cells operating at constant pressure; temperature coefficients were derived and compared with data from the literature. (RWR)

2238 RECENT IMPROVEMENTS IN HIGH PERFORMANCE SECONDARY BATTERIES FOR USE ON OFFSHORE PLATFORMS. Snyder, D.N. pp 127-133 of Proceedings of the seventh annual offshore technology conference. Vol. II. Dallas; Offshore Technology Conference (1975).
From Offshore technology conference; Houston, Texas, USA (5 May 1975).
See CONF-750516--P2.
The unique operating environment of the offshore platforms makes high quality reliable standby power essential. Secondary batteries are an important part of standby power systems especially for engine and turbine starting, emergency lighting, communications, and control systems. Recently, improved batteries have been produced that offer the platform owner and operator better performance in these critical services. This paper reviews recent improvements, particularly in the pocket plate nickel cadmium battery.

2239 DETERMINATION OF ACCEPTABLE CONTAMINANT ION CONCENTRATION LEVELS IN A TRULY MAINTENANCE-FREE LEAD ACID BATTERY. Pierson, J.R.; Weinlein, C.E.; Wright, C.E. (Globe-Union Inc., Milwaukee). pp 97-108 of Power sources 5. Collins, D.H. (ed.). New York; Academic Press Inc. (1975).
From 9. international power sources symposium; Brighton, UK (17 Sep 1974).
See CONF-740908--.
Maintenance-free lead acid cells inoculated with various concentrations of 24 contaminant ions were tested to determine the effect of the contaminants on the gas generation rate of the cells. A constant voltage overcharge test was employed in the evaluation. Nine of the elements exhibited no distinguishable effect on the gas generation at the highest concentration investigated (5000 ppM) while six elements increased gas generation and therefore water loss on overcharge even when present at concentrations of 10 ppM or lower.

2240 TECHNOLOGICAL PROGRESS IN PACEMAKER DESIGN: HERMETIC SEALING. Buffet, J. (L'Electron Appl, Montrouge, France). Med. Prog. Technol.; 3: No. 3, 133-142(1975).
Clinical statistics covering the life of pacemakers powered by mercury batteries show that an average life of 3 years has not yet been obtained. Strangely, the life does not seem to depend on the current consumed by the pacemaker, whether of the demand or asynchronous type. A study of the behavior of 229 mercury batteries discharged in a dry atmosphere showed that 92% of the batteries were still functioning after 54 to 57 months.

It is deduced that pacemaker life is shortened by the infiltration of moisture into the batteries when molded in an epoxy. A technology for the hermetic encapsulation of a pacemaker is described. This technology is applied to both mercury and lithium batteries. The results obtained with 5835 instruments over periods of up to 36 months were gathered. No batteries were found prematurely depleted. 19 refs.

2241 GAS RECOMBINATION LEAD--ACID BATTERIES. Mahato, B.K.; Laird, E.C. (Globe-Union Inc., Milwaukee). pp 23-41 of Power sources 5. Collins, D.H. (ed.). New York; Academic Press Inc. (1975).
From 9. international power sources symposium; Brighton, UK (17 Sep 1974).
See CONF-740908--.
The design of a structurally controlled sealed lead--acid cell has been defined in terms of parametric correlations and its preparation procedures are outlined. The ability to scale up by means of the developed correlations has been demonstrated by preparation and test of 0.9, 7.5, and 47.5 A h cells. These test units have exhibited continuous constant current overcharge capability at rates up to C/20 and cycle life characteristics similar to sealed nickel--cadmium batteries. The internal pressure of these test units remained less than 30 N/cm$^2$. Positive grid corrosion appears to be the main failure mode.

2242 BATTERY CHARGING AT LOW TEMPERATURE. Willihnganz, E. pp 43-53 of Power sources 5. Collins, D.H. (ed.). New York; Academic Press Inc. (1975).
From 9. international power sources symposium; Brighton, UK (17 Sep 1974).
See CONF-740908--.
Charge acceptance of a lead--acid battery at -40°F may be limited by either the positive or the negative plates. In the negative, it is the slow solution rate of lead sulfate which controls. A tenfold increase in charge acceptance occurred when an organic expander was purified. In the positive plate, the charge product produces a high counter-e.m.f. which stops charge at the usual voltage. At a higher voltage, better acceptance occurs over a limited range, but the charge product is not lead dioxide, and its usefulness under practical conditions has not been worked out.

2243 FAST CHARGING OF SEALED NICKEL--CADMIUM BATTERIES: THEORY AND PRACTICE. Hodge, B.J.R. (SAFT, Ltd., Hampton, Eng.). pp 211-231 of Power sources 5. Collins, D.H. (ed.). New York; Academic Press Inc. (1975).
From 9. international power sources symposium; Brighton, UK (17 Sep 1974).
See CONF-740908--.
The electrical, electrochemical and physical behavior of sealed nickel--cadmium cells during fast charge are examined. Various existing charge control systems are re-examined, and two new systems are described, one a simple system for use at normal temperatures, the other suitable for a wide temperature range (--20°C to +50°C). Life, reliability, fading and charging efficiency at high temperature are all improved by fast charging, and the results of a study in depth over a wide temperature range are presented. Pulse charging is also studied, and reasons are given to support the finding that the longer the pulse, the more efficient the charge.

2244 NI--$H_2$ PERFORMANCE VERSUS NI--CD. Font, S.; Goualard, J. (Societe des Accumulateurs, Romainville, France). pp 331-346 of Power sources 5. Collins, D.H. (ed.). New York; Academic Press Inc. (1975).
From 9. international power sources symposium; Brighton, UK (17 Sep 1974).
See CONF-740908--.
A Ni--$H_2$ sealed system with an energy density of 60 W h/kg is especially attractive for space applications where a high energy to weight ratio and reliability are of major concern and compares favorably to Ni--Cd. Ni--$H_2$ construction parameters are presented as well as experimental data covering electrical characteristics, charge retention and cycling performances. Main differences from the Ni--Cd system are attributed to the negative hydrogen electrode characteristics. The poor charge retention of Ni--$H_2$ seems to depend on $H_2$ pressure and the activity of the negative electrode catalyst. Ni--$H_2$ and Ni--Cd cells cycled on the same basis, i.e. 8 h cycle duration at 22°C and 72 percent D.O.D., have already achieved over 1000 cycles.

2245 POLARIZATION AND CORROSION EXPERIMENTS ON SODIUM--SULPHUR CELLS. Bones, R.J.; Brook, R.J.; Markin, T.L. (Atomic Energy Research Establishment, Harwell, Eng.). pp 539-557 of Power sources 5. Collins, D.H. (ed.). New York; Academic Press Inc. (1975).
From 9. international power sources symposium; Brighton, UK (17 Sep 1974).
See CONF-740908--.
A current interruption device employing a Tektronix 543B oscilloscope to trigger a relay has been used to separate the resistive (IR) voltage losses and polarization voltage losses during charge and discharge of sodium--sulphur cells based on $\beta$-alumina electrolytes. Polarization voltage losses have been shown to depend on the state of charge of the cells as well as on current density. Polarization losses on discharge are higher when the sulphur compartment of the battery contains a single phase polysulphide with a composition between $Na_2S_3$ and $Na_2S_5$ than when the sulphur compartment contains a two phase mixture of $Na_2S_5$ and sulphur. The reverse is true on charge. The causes of the polarization voltage losses are discussed. Corrosion of the stainless steel outer casing/current collector has been investigated. The bright metallic surface seen on some stainless steel current collectors has been shown to occur during the final stages of discharge of the cell and is due to polarization of the melt resulting in the formation of $Na_2S_2$ close to the steel. The extent of the polarization depends on the graphite felt/steel contact and the current density.

2246 LEAD--LEAD II SULFATE SYSTEM IN SULFURIC ACID STUDIED BY THE IMPEDANCE MEASURING METHOD. Strochkova, E.M.; Rybalka, K.W.; Leikis, D.I. (Inst. of Electrochemistry, Moscow). Elektrokhimiya; 11: No. 9, 1439-1442(1975). (In Russian).
The impedance at the boundary between lead and sulfuric acid saturated with $PbSO_4$ was measured for dilute solutions at 25° and 20 Hz to 2 kHz for polished lead and lead covered with $PbSO_4$. The diffusion of $PbSO_4$ was found to play an important role in electrode reactions. (RWR)

2247 ACTUAL SERVICE LIFE AND BENCH CYCLE LIFE OF LEAD--ACID BATTERY FOR ELECTRIC VEHICLE USE. Kamada, K.; Okazaki, I.; Takagaki, T. (Japan Storage Battery Co., Ltd., Tokyo). pp 4-26 of Battery Council International convention:

1975. Chicago; Battery Council International (1975).
From 87. Battery Council International convention; Hollywood, Florida, USA (8 Apr 1975).
See CONF-7504129--.
A battery bench test, which would give a better representation of actual service conditions, was devised. The results of the test are compared with results obtained in actual use. 9 figures, 4 tables.

2248 RECHARGEABLE PILE TYPE SILVER ZINC BATTERY INVESTIGATIONS FOR USE IN HIGH POWER AIRBORNE APPLICATIONS. Blagdon, L.J. pp 278-280 of IEEE national aerospace electronics conference. New York; Inst. of Electrical and Electronics Engineers (1975).
From IEEE national aerospace electronics conference; Dayton, OH, USA (10 Jun 1975).
The use of a silver/zinc pile-type, rechargeable battery in megawatt-level airborne applications was investigated. Cell performance of two (2) amps per square inch with 30-second voltages of 1.32 volts was achieved. System level projections placed a 4-megawatt system at 25 cubic feet and 3500 pounds utilizing a modular concept. Present contract status includes work on full-scale (40-cell) submodules.

2249 MAINTENANCE-FREE BATTERIES: SOME ASPECTS OF GASSING. Sokolov, U.S.; Crosby, L.J. (NL Industries, Heightstown, NJ). pp 145-149 of Battery Council International convention: 1975. Chicago; Battery Council International (1975).
From 87. Battery Council International convention; Hollywood, Florida, USA (8 Apr 1975).
See CONF-7504129--.
The correlation between water loss and positive grid composition is examined. The test cell is described, and results on the transfer of Bi, Sb, Cu, and Ag are tabulated. It was concluded that, under the severe conditions used in the experiments (bare positive grids), some transfer of trace elements to the negative plate took place; however, the gassing on the negative plate was essentially the same, regardless of whether it was cycled against low-bismuth primary or refined secondary lead positive grids. 11 figures. (RWR)

2250 DESULFATION OF THE LEAD STORAGE-BATTERY PLATES. Zhulidov, N.A.; Trukhin, P.P. USSR Patent 454,617. 25 Dec 1974. Filed date 12 Jan 1973.
LEAD-ACID BATTERIES;BATTERY CHARGING;PLATES

2251 REDUCING DENDRITE FORMATION WHEN CHARGING ACCUMULATOR BATTERIES. British Patent 1,377,732. 18 Dec 1974. Filed date 7 Apr 1972. 1p.
BATTERY CHARGING;HZ RANGE;KHZ RANGE; MECHANICAL VIBRATIONS;LEAD-ACID BATTERIES; DENDRITES

2252 PHASE EQUILIBRIUM DIAGRAM OF THE SYSTEM SODIUM POLYSULFIDE ($Na_2S_x$)--SULFUR. Coleman, D.S.; Heal, M. (Dep. Mater. Technol., Univ. Technol., Loughborough/Leicestershire, England). Inst. Min. Metall., Trans., Sect. C; 83: C258-C259(Dec 1974).
Study of build-up of Na sulfides at β-alumina--S interface. SODIUM-SULFUR BATTERIES; CHEMICAL REACTIONS;SODIUM SULFIDES;SULFUR;PHASE DIAGRAMS;ALUMINIUM OXIDES;INTERFACES;MELTING POINTS

2253 CHARGING OF AN ACCUMULATOR. Kubo, K. GE 2,348,447. 7 Nov 1974. Filed date 20 Apr 1973. 11p.
Method in which spent electrolyte is replaced by electric charged electrolyte. BATTERY CHARGING;ELECTROLYTES

2254 HYDRAULICALLY RECHARGEABLE,DEPOLARIZED METAL--GAS BATTERY SYSTEM. Leparulo, A.F.; Grun, C. (to Electromedia, Inc.). GE 2,417,571. 7 Nov 1974. Filed date 13 Apr 1973. 42p.
Gas-Zn system. METAL-GAS BATTERIES;ZINC; BATTERY CHARGING;ELECTRIC-POWERED VEHICLES; BATTERY CHARGERS

2255 SELECTING A STANDBY BATTERY. Ohntrup, F.F. (Eltra Co, Plymouth Meeting, Pa). Plant Eng. (Barrington, Ill.); 28: No. 22, 65-67(31 Oct 1974).
Lead-calcium batteries require the addition of only about one-tenth of water of equivalent lead-antimony batteries; this consumption remains constant over the life of the battery. Lead-calcium batteries will normally require water at about 3 to 5 year intervals, but it is not unusual to find installations where watering is required only every 10 years.

2256 SEA WATER BATTERY. Pollack, M.J. (to Honeywell, Inc.). German(FRG) Patent 2,412,825. 3 Oct 1974. Filed date 19 Mar 1973. 6p.
Patent; Zn/KOH/Ni hydroxide oxide 1.5 V, 2.09 W/cm³. NICKEL-ZINC BATTERIES;ZINC;NICKEL HYDROXIDES;NICKEL OXIDES;POTASSIUM HYDROXIDES; GLASS;PERFORMANCE;DESIGN;SEAS

2257 EFFECT OF BRINE LEVEL ON THE VOLTAGE OF MERCURY-TYPE CHLOR-ALKALI CELLS. Danna, P.A. (Olin Corp., Stamford, CT). J. Electrochem. Soc.; 121: No. 10, 1286-1289(Oct 1974).
One of the neglected variables affecting the operating voltage of mercury-type chlor-alkali cells is the level of the cell brine relative to the tops of the graphite anodes within the cell. Laboratory data were analyzed and scaled up to predict the magnitude of this effect in a typical commercial mercury cell. (Electr. Electron Abstr.)

2258 LEAD BATTERY STORABLE WITHOUT ELECTROLYTE. Ziegler, S. (to Bosch, Robert, GmbH). German(FRG) Patent 2,313,285. 19 Sep 1974. Filed date 16 Mar 1973. 8p.
Patent; oxidation of anode prevented by Pb--10 percent Na alloy. LEAD-ACID BATTERIES; STORAGE;ANODES;OXIDATION;LEAD BASE ALLOYS; SODIUM ALLOYS

2259 MOTIVE POWER BATTERIES. Ohntrup, F.F. (Eltra Co., Plymouth Meeting, PA). Plant Eng. (Barrington, Ill.); 28: No. 19, 129-31(Sep 1974).
Necessity for prompt action in event of malfunction. ELECTRIC-POWERED VEHICLES;ELECTRIC BATTERIES;OPERATION

2260 USE, MAINTENANCE AND STORAGE PROPERTIES OF LEAD/ACID STARTER BATTERIES. Hindriks, J. Polytech. Tijdschr. Elektrotech./Elektron.; 29: No. 17, 571-573(21 Aug 1974). (In Dutch).
A general review of historical development and present state-of-the-art is given. Various graphs and tables illustrate continuing

improvements in efficiency, storage capacity, etc., as well as increasingly diversified uses of $Pb/H_2SO_4$ accumulator starter batteries. (Electr. Electron Abstr.)

2261 RECHARGEABLE ELECTROCHEMICAL CELLS. Ohsawa, K.; Hirasa, K.; Kinoshita, H. (to Furukawa Electric Co., Ltd.; Furukawa Battery Co., Ltd.). German(FRG) Patent 2,404,418. 08 Aug 1974. Filed date 31 Jan 1973. 26p.
Additive to suppress dendritic growth on Zn; patent. NICKEL-ZINC BATTERIES;ANODES;BATTERY CHARGING;ADDITIVES;AMMONIUM COMPOUNDS; PERFORMANCE;QUATERNARY COMPOUNDS

2262 ACCURATE CALCULATIONS OF THERMODYNAMIC CHARACTERISTICS OF SILVER--CADMIUM AND SILVER--ZINC STORAGE BATTERIES. Dibrov, I.A.; Gorelik, D.M. J. Appl. Chem. USSR (Engl. Transl.); 47: No. 8, 1928-1929(Aug 1974).
Translated from Zh. Prikl. Khim.; 47: No. 8, 1876-1877(Aug 1974).
E, dE/dT, $\Delta H^o$, $\Delta G^o$. SILVER-CADMIUM BATTERIES; SILVER-ZINC BATTERIES;THERMODYNAMIC PROPERTIES; ELECTRIC POTENTIAL;TEMPERATURE DEPENDENCE; ENTHALPY;FREE ENERGY

2263 ELECTRODE KINETICS OF THE ALKALI METALS IN $ALCL_3$-PROPYLENE CARBONATE SOLUTION. Jorne, J.; Tobias, C.W. (Univ. of Calif., Berkeley). J. Electrochem. Soc.; 121: No. 8, 994-1000(Aug 1974).
ELECTRODES;CHEMICAL REACTION KINETICS;ALKALI METALS;ALUMINIUM CHLORIDES;CARBONIC ACID ESTERS; DEPOSITION;DISSOLUTION;ALKALI METAL COMPOUNDS; CHLORIDES;MEDIUM TEMPERATURE;CURRENT DENSITY; ELECTRIC BATTERIES

2264 BATTERY ENERGY DENSITY RAISED BY MODERN MATERIALS. Des. Eng. (London); 19-21(Aug 1974).
ELECTRIC BATTERIES;SODIUM-SULFUR BATTERIES; PERFORMANCE

2265 DEVICE FOR SEPARATING ELECTROLYTE CARRIED BY HYDROGEN DURING RECHARGING OF A STORAGE BATTERY. Martin, G. (to Etat Francais). US Patent 3,825,444. 23 Jul 1974. Filed date 28 Jul 1972. 4p.
ELECTRIC BATTERIES;BATTERY CHARGING; SUBMARINES;ELECTROLYTES;HYDROGEN;POLLUTION; IMPURITIES

2266 PROLONGING THE SERVICE LIFE OF AN ALKALINE NICKEL--IRON BATTERY. Ermolov, O.R.; Morozov, V.N.; Molotkova, E.N.; Pudak, V.V.; Prokhorov, B.I. USSR Patent 435,574. 5 Jul 1974. Filed date 8 Jan 1973.
Patent; rinsing plates and treating with organic acid. IRON-NICKEL BATTERIES;HYDROXIDES; ELECTROLYTES;OXALIC ACID;LIFETIME

2267 CHECKING THE AIR TIGHTNESS OF A BATTERY. Lezhnev, P.I.; Baranov, A.I.; Pozin, Yu.M. USSR Patent 434,522. 30 Jun 1974. Filed date 14 Feb 1973.
Patent; method. ELECTRIC BATTERIES; RELIABILITY;AIR;LEAKS;LEAK TESTING; PHENOLPHTHALEIN

2268 CONTROL OF THE DISCHARGE STATE OF A BATTERY AT VARYING DISCHARGE CURRENTS. Steinmann, H. (to Bosch, Robert, GmbH). GE 2,261,046. 27 Jun 1974. Filed date 14 Dec 1972. 11p.
ELECTRIC BATTERIES;OPERATION;ELECTRIC POTENTIAL

2269 NICKEL--CADMIUM AIRCRAFT BATTERY RUN-A-WAY. Tech Air; 30: 2-5(Jun 1974).
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15 A-h. SODIUM-SULFUR BATTERIES;PERFORMANCE; ELECTRIC POTENTIAL;DESIGN;ELECTRIC CURRENTS; ELECTRIC CONDUCTIVITY

2381 HIGH ENERGY DENSITY NICKEL--CADMIUM BATTERIES. Menard, C.J. (Gould Inc., Gould Labs., Energy Technology). pp 95-7 of Proceedings of 7th Intersociety Energy Conversion Engineering Conference, Hilton Inn, San Diego, California, September 25-29, 1972. Washington, DC; American Chemical Society (1972).
From 7. intersociety energy conversion engineering conference; San Diego, California, USA (25 Sep 1972).
Ni/KOH/Cd, 27 Wht/lb, 6.7 A-h. NICKEL-CADMIUM BATTERIES;NICKEL;PERFORMANCE;POTASSIUM HYDROXIDES;ELECTRIC POTENTIAL

2382 SPACECRAFT NICKEL--CADMIUM BATTERY CYCLE LIFE ASSESSMENT. Fono, P. (Hughes Aircraft Co.). pp 98-102 of Proceedings of 7th Intersociety Energy Conversion Engineering Conference, Hilton Inn, San Diego, California, September 25-29, 1972. Washington, DC; American Chemical Society (1972).
From 7. intersociety energy conversion engineering conference; San Diego, California, USA (25 Sep 1972).
NICKEL-CADMIUM BATTERIES;PERFORMANCE TESTING; LIFETIME;SATELLITES

2383 METAL--AIR (OXYGEN) BATTERIES. Wagner, O.C. (Power Sources Tech., US Army Electron. Technol. Devices Lab., Fort Monmouth, NJ). Power Sources Symp., Proc.; 25: 71-4(1972).
Cd/air, Zn/O. METAL-GAS BATTERIES;ZINC-AIR BATTERIES;CADMIUM;AIR;ZINC;OXYGEN;BATTERY CHARGING;PERFORMANCE

2384 PRIMARY--SECONDARY BATTERY HYBRID SYSTEMS. Sulkes, M.J. (Power Sources Tech. Area, US Army Electron. Technol. Devices Lab., Fort Monmouth, NJ). Power Sources Symp., Proc.; 25: 77-81(1972).
PRIMARY-SECONDARY HYBRID BATTERIES; PERFORMANCE;NICKEL-CADMIUM BATTERIES;ZINC; MERCURY OXIDES;MAGNESIUM;MANGANESE OXIDES;ZINC-AIR BATTERIES

2385 LITHIUM/SULFUR SECONDARY CELLS. Cairns, E.J.; Shimotake, H.; Gay, E.C.; Selman, J.R. (Argonne National Lab., IL). pp 432-434 of Twenty-third meeting of the International Society of Electrochemistry. Stockholm; International Society of Electrochemistry (1972).
From 23. meeting of the international Society of Electrochemistry; Stockholm, Sweden (27 Aug 1972).

Li in Si steel or Ni/LiF--LiCl--KCl/S in C. LITHIUM-SULFUR BATTERIES;OFF-PEAK ENERGY STORAGE;AUTOMOBILES;ELECTRIC-POWERED VEHICLES; LITHIUM FLUORIDES;LITHIUM CHLORIDES;POTASSIUM CHLORIDES;ELECTRIC CURRENTS;ELECTRIC POTENTIAL; GEOMETRY;ADDITIVES;LIFETIME;PERFORMANCE TESTING

2386 COMPARISON BETWEEN CALCULATED AND MEASURED BEHAVIOR OF A LEAD ACID BATTERY AND REASONS FOR THE DEVIATIONS. Runge, W. (Inst. Stromrichtertech. Elektr. Antriebe, Tech. Hochsch. Aachen, Aachen, Ger.). Elektrotech. Z., A; 93: No. 2, 67-72(1972).
LEAD-ACID BATTERIES;ELECTRIC CONDUCTIVITY; BATTERY CHARGING;LEAD SULFATES;PERFORMANCE

2387 IMPROVEMENT IN THE ELECTRICAL CHARACTERISTICS OF LEAD ACCUMULATORS BY ULTRASONIC TREATMENT OF THE ELECTROLYTES. Mihu, V.P.; Gavrila, I. (Univ. Bucharest, Rumania). An. Univ. Bucuresti, Fiz.; 21: 45-60(1972). (In German).
LEAD-ACID BATTERIES;ELECTRICAL PROPERTIES; OPTIMIZATION;PERFORMANCE;ULTRASONIC WAVES; ELECTROLYTES

2388 LOCKHEED ELECTRIC POWER SOURCE. Roll, R.R. (Lockheed Missiles and Space Co., Palo Alto, CA). pp 209-12 of Proceedings of the symposium on batteries for traction and propulsion, Columbus, Ohio, 7-8 Mar 1972. Columbus, OH; Electrochemical Society (1972).
From Symposium on batteries for traction and propulsion; Columbus, OH (7-8 Mar 1972).
Na or Li/$H_2O$. METAL-NONMETAL BATTERIES; LITHIUM;SODIUM;WATER;PERFORMANCE;ELECTRIC-POWERED VEHICLES

2389 (AD/A--005065) WETTABILITY OF THE CASING AND ELECTROLYTE LEAKAGE IN AIRTIGHT NICKEL--CADMIUM STORAGE BATTERIES. Boldin, R.V.; Sushentsova, S.N.; Milyutin, N.N. Translated from Sb. Rab. Khim. Istochnikam Toka; 7: 161-163(1972). 7p. (FSTC-HT--23-1002-74). NTIS $3.25.
The results of studying the wettability of 08KP steel used for manufacture of storage battery casings, with an alkali solution at various potentials of the metal's surface are presented. It is shown that greatest wettability, and consequently, an increased tendency toward electrolyte leakage along the storage battery casing is observed when the casing is connected electrically to the negative block of electrodes; smallest wettability is observed when the casing is insulated from the working electrodes. (GRA)

2390 HIGH POWER ELECTROCHEMICAL SYSTEMS. Cairns, E.J.; Steunenberg, R.K.; Shimotake, H. (Argonne National Lab., IL). pp 361-364 of From electrocatalysis to fuel cells. Sandstede, G. (ed.). Seattle; University of Washington Press (1972).
The requirements of high-specific-power, high-specific-energy batteries for spacecraft, off-peak energy storage, vehicle propulsion, etc., are considered. The following promising cells are briefly reviewed: Na/$\beta$-$Al_2O_3$/S, Li/$LiCl/Cl_2$, Li--Al/LiCl--KCl/Cl--C, Li/LiF--LiCl--LiI/Se, and Li/LiBr--RbBr/S. Operating characteristics and current problems are included. 2 figures, 1 table. (RWR)

2391 (ANL-Trans--1060) MEASUREMENT OF THE CELL VOLTAGE OF $ThO_2$--$Y_2O_3$-SOLID ELECTROLYTE CELLS IN THE RANGE OF MIXED CONDUCTION. Reetz, T. Translated from Z. Phys. Chem. (Leipzig); 250: No. 3/4, 205-216(1972). 16p. Dep. NTIS $3.50.
The cell voltage drop of galvanic chains with oxygen ion-conducting solid electrolytes by electron transfer can be estimated with a knowledge of either the parameters for electron conduction of the transfer numbers applicable to different oxygen pressures. For a given electrode system, it is possible to determine an optimum reference system in terms of the mean transfer number. Approximation equations are derived for the relationship between the transfer number and mean transfer number of galvanic chains. The electrical conduction properties of the $ThO_2$--$Y_2O_3$ solid electrolyte are discussed on the basis of experimental results with the chains $Pt/H_2,H_2O(20^oC/sub\ sat./)/ ThO_2$ + 20 Mol- percent YO/sub 1,5/air/Pt (Chain 1) and Ni/Na,$Na_2O$ (sat.)/$ThO_2$ + 20 Mol-percent YO/sub 1,5/$O_2$(p'$o_1$)/Ag/Ni (Chain 2) and literature data. The measured values of chain 2 at different oxygen pressures of the reference system furnished values for electron conduction parameters. 7 figures, 4 tables.

2392 PRESERVATION OF A LEAD--ACID STORAGE BATTERY. Aranchuk, E.S.; Emel'yanov, N.M.; Dubrovskaya, T.F. Otkrytiya, Izobret., Prom. Obraztsy, Tovarnye Znaki; 49: No. 3, 176(1972).
Preserving lead--acid batteries by replacing the electrolyte with a depassivating solution of boric acid ($H_3BO_3$) is explained. (RWR)

2393 IMPEDANCE SPECTRUM OF ELECTROCHEMICAL CURRENT SOURCES. Euler, K.J. Electrochim. Acta; 17: No. 4, 619-634(1972). (In German).
Measurement techniques and analysis are discussed. Charge-transfer resistance and a diffusion control quantity can usually be evaluated; often the charge-transfer resistance can be divided into parts at the two electrodes. (RWR)

2394 USE OF PALLADIUM-CATALYZED AIR CATHODES IN A SECONDARY ZINC--AIR CELL. Thacker, R. (General Motors Corp., Warren, MI). Energy Convers.; 12: No. 1, 17-20(1972).
This type of air cathode degrades with use. It is suggested that the cause is dissolution of the catalyst during charging. As a result, palladium is deposited with zinc. Such deposition leads to internal shorting and lowered charging efficiency (because increased amounts of charging current are used to liberate hydrogen). (RWR)

2395 TRANSIENT PRESSURE CONSIDERATIONS IN CHARGE CONTROL OF SEALED BATTERIES. Gross, S. (Boeing Co., Seattle). J. Electrochem. Soc.; 119: No. 3, 347-349(1972).
A charging mode with a gradual initial pressure increase instead of a linear increase reduced structural damage to cells due to transient pressure effects. (RWR)

2396 RAPID CHARGING BATTERIES FOR ELECTRIC PROPULSION SYSTEMS. Sparks, R.H. New York; Society of Automotive Engineers (1972). 12p.
Nickel--cadmium batteries with capacities of 24 amp-hr at 28 V were successfully rapid-charged in 5 to 10 min. Similarly, 190 amp-hr lead--acid batteries were rapid-charged at 20 to 30 min. In both cases, application of depolarization discharge pulses was successful in preventing capacity fade and in minimizing battery heating and gassing near full charge at high charge rates.

2397 RECHARGEABLE ALKALINE ELECTROLYTE CELLS, AND METHODS OF RESTORING THE ELECTRICAL CAPACITY OF SUCH CELLS. Hodge, B.J.R. (to Societe des Accumulateurs Fixes et de Traction). British Patent 1,256,980. 15 Dec 1971. Filed date 19 Dec 1969. 5p.
After Ni/Cd or Ag/Cd batteries had undergone several charge/discharge cycles, their full electrical capacity was maintained by connecting a resistance across the electrodes (causing a permanent short circuit). The electrochemical reactions are discussed. The battery is suitable for uses allowing complete discharge. (RWR)

2398 OPERATION OF STORAGE BATTERIES USED AT VERY LOW TEMPERATURES. Gomis, J.P.; Jarrousseau, J.C. (to Societe des Accumulateurs Fixes et de Traction). French Patent 2,061,951. 30 Jul 1971. Filed date 6 Oct 1969. 12p.
Ag/Cd or Ni/Cd batteries with aqueous potassium hydroxide electrolyte can be operated down to -60°. The electrolyte is so concentrated (> 7N) that, after charging at -30°, the solid phase which forms at the discharge temperature is not ice, but $KOH.4H_2O$, which is conducting. (RWR)

2399 INTERNAL RESISTANCE OF THE LEAD AND SILVER--ZINC STORAGE BATTERIES DURING SHORT CIRCUITS. Bayunov, V.V.; Dasoyan, M.A. Elektrotekhnika; No. 7, 59-60(Jul 1971). (In Russian).
LEAD-ACID BATTERIES;SILVER-ZINC BATTERIES; ELECTRIC IMPEDANCE

2400 INTERNAL RESISTANCE OF LEAD AND SILVER--ZINC STORAGE BATTERIES DURING SHORT CIRCUITS. Bayunov, V.V.; Dasoyan, M.A. Elektrotekhnika; No. 7, 59-60(Jul 1971). (In Russian).
LEAD-ACID BATTERIES;SILVER-ZINC BATTERIES; ELECTRIC CONDUCTIVITY;ELECTRIC IMPEDANCE

2401 EVALUATION OF THE EFFECTIVE GRID RESISTANCE IN LEAD--ACID SECONDARY BATTERY CELLS. Euler, K.J. Arch. Elektrotech. (Berlin); 54: No. 2, 122-126(Jul 1971). (In German).
At the interface between electrode and electrolyte, electrons are set free by the electrode reaction. Inside the electrode, electrons have to migrate through several series resistors; thus, a part of the cell voltage is lost. In heavily discharged automotive batteries with a discharge of 3 to 6 min, the voltage drop across the metallic grid can no longer be neglected. A measuring procedure is found for grid resistance optimization which allows the evaluation of effective grid resistances, and predictions for voltage drop.

2402 CAUSES OF FAILURE IN SEALED NICKEL--CADMIUM BATTERIES. Gross, S. (Boeing Co., Seattle, WA). Energy Convers.; 11: No. 2, 39-45(Jun 1971).
NICKEL-CADMIUM BATTERIES;FAILURES; RELIABILITY;SATELLITES;SEALS;HYDROXIDES

2403 MEANING OF ''EFFECTIVENESS'' WHEN APPLIED TO ELECTRIC BATTERIES. Euler, K.J. (Varta AG, Hanover, W. Ger.). Metalloberflaeche; 25: No. 5, 163-7(May 1971). (In German).
FUEL CELLS;ELECTRIC BATTERIES;EFFICIENCY; PERFORMANCE

2404 RELIABILITY PROBLEM OF THE MULTI-ELEMENT CHEMICAL POWER SOURCES. Belyaev, B.V.; Iosifov, A.S. Izv. Vyssh. Uchebn. Zaved., Elektromekh.; No. 5, 574-577(May 1971). (In Russian).
The reliability is analyzed of silver--zinc battery operation.

2405 MAXIMIZING THE USABLE ENERGY FROM A SPACECRAFT POWER SYSTEM. Ostwald, L.T. (Ball Bros. Res. Corp., Boulder, CO). pp 985-94 of Society of Automotive Engineers, Intersociety Energy Conversion Engineering Conference, Boston, MA, August 3-5, 1971, proceedings. Boston; Society of Automotive Engineers (1971).
From Intersociety Energy Conversion Engineering Conference; Boston, MA (3-5 Aug 1971).
Solar power system using Si cell array and Ni--Cd battery. BUDGETS;ELECTRIC BATTERIES; SPACECRAFT POWER SUPPLIES;SIMULATION;SILICON SOLAR CELLS;OPTIMIZATION;SOLAR CELL ARRAYS

2406 CANDIDATE ELECTRICAL POWER SYSTEMS FOR SPACE STATION. McCarty, L.H. (Gen. Elec. Co., Valley Forge, PA); Boretz, J.E. (TRW Systems Group, Redondo Beach, CA). New York; AIAA (1971). 11p. Members, $1.50; Nonmembers, $2.00.
From AIAA Space Systems Meeting; Denver, CO (19-20 Jul 1971).
SPACECRAFT POWER SUPPLIES;COMPARATIVE EVALUATIONS;SOLAR CELL ARRAYS;RADIOISOTOPE GENERATORS;SPACE POWER REACTORS;ELECTRIC BATTERIES;PERFORMANCE

2407 THERMAL PHENOMENA IN FUEL CELLS AND BATTERIES. Baker, B.S.; Gidaspow, D.; Wasan, D. (Energy Res. Corp., Bethel, CT). Adv. Eletrochem. Electrochem. Eng.; 8: (1971).
FUEL CELLS;ELECTRIC BATTERIES;THERMODYNAMIC PROPERTIES;HEAT TRANSFER

2408 LITHIUM/SULFUR BATTERIES FOR ELECTRIC VEHICLE PROPULSION. Kyle, M.L.; Shimotake, H.; Steunenberg, R.K.; Martino, F.J.; Rubischko, R.; Cairns, E.J. (Argonne National Lab., Upton, NY). pp 80-95 of 6th Intersociety energy conversion engineering conference. New York; Society of Automotive Engineers, Inc. (1971).
From 6. Intersociety energy conversion engineering conference; Boston, MA (3 Aug 1971).
Li halide electrolyte. LITHIUM-SULFUR BATTERIES;ELECTRIC-POWERED VEHICLES;PERFORMANCE; LITHIUM HALIDES;CATHODES;DESIGN;ELECTRIC CURRENTS;ELECTRIC POTENTIAL;DIELECTRIC MATERIALS;HIGH TEMPERATURE;AUTOMOBILES

2409 BATTERY AND THIRD ELECTRODE PERFORMANCE CHARACTERISTICS FOR VARYING CHARGE AND DISCHARGE RATES. Breeskin, S.D.; Taylor, A.D. pp 181-187 of 6th Intersociety energy conversion engineering conference. New York; Society of Automotive Engineers, Inc. (1971).
From 6. Intersociety energy conversion engineering conference; Boston, MA (3 Aug 1971).
20 A-h, 24 cell, sealed battery. SPACE VEHICLES;PERFORMANCE;NICKEL-CADMIUM BATTERIES; SATELLITES;MEDIUM TEMPERATURE;ELECTRIC POTENTIAL;DESIGN;BATTERY CHARGING

2410 BATTERY CELL WITH THIRD ELECTRODE PERFORMANCE TEST RESULTS. Gaz, R.A. pp 188-

194 of 6th Intersociety energy conversion engineering conference. New York; Society of Automotive Engineers, Inc. (1971).
From 6. Intersociety energy conversion engineering conference; Boston, MA (3 Aug 1971).
20 A-h cell. NICKEL-CADMIUM BATTERIES; PERFORMANCE TESTING;ELECTRIC POTENTIAL;MEDIUM TEMPERATURE;HEATING;ELECTRONIC CIRCUITS;BATTERY CHARGING;TEMPERATURE DEPENDENCE;EFFICIENCY; CALORIMETERS;BATTERY CHARGERS;SPACE VEHICLES

2411 LITHIUM/SULFUR BATTERIES FOR ELECTRIC VEHICLE PROPULSION. Kyle, M.L.; Shimotake, H.; Steunenberg, R.K.; Martino, F.J.; Rubischko, R.; Cairns, E.J. (Argonne National Lab., IL). pp 80-95 of 1971 intersociety energy conversion engineering conference. New York; Society of Automotive Engineers, Inc. (1971).
From Intersociety energy conversion engineering conference; Boston, MA (3 Aug 1971).
0.52 A-hr/cm$^2$ at 0.52 A/cm$^2$. ELECTRIC-POWERED VEHICLES;LITHIUM-SULFUR BATTERIES; AUTOMOBILES;PROPULSION;COST;ELECTROLYTES; CURRENT DENSITY;ELECTRODES;PERFORMANCE; FEASIBILITY STUDIES;LITHIUM BROMIDES;RUBIDIUM BROMIDES;ELECTRIC POTENTIAL

2412 BATTERY AND THIRD ELECTRODE PERFORMANCE CHARACTERISTICS FOR VARYING CHARGE AND DISCHARGE RATES. Breeskin, S.D.; Taylor, A.D. pp 181-187 of 1971 intersociety energy conversion engineering conference. New York; Society of Automotive Engineers, Inc. (1971).
From Intersociety energy conversion engineering conference; Boston, MA (3 Aug 1971).
20 A-hr, 24-cell, sealed batteries. PERFORMANCE;NICKEL-CADMIUM BATTERIES;CONTROL SYSTEMS;DESIGN;SPACE VEHICLES;SATELLITES;MEDIUM TEMPERATURE

2413 BATTERY CELL WITH THIRD ELECTRODE PERFORMANCE TEST RESULTS. Gaz, R.A. pp 188-194 of 1971 intersociety energy conversion engineering conference. New York; Society of Automotive Engineers, Inc. (1971).
From Intersociety energy conversion engineering conference; Boston, MA (3 Aug 1971).
20 A-hr. NICKEL-CADMIUM BATTERIES; PERFORMANCE;MEDIUM TEMPERATURE;TEMPERATURE DEPENDENCE;ELECTRICAL PROPERTIES;HEATING; PERFORMANCE TESTING;ELECTRONIC CIRCUITS; ELECTRIC POTENTIAL

2414 (AD/A--001498) SELF-DISCHARGE OF SILVER--ZINC BATTERIES FILLED WITH ELECTROLYTE. Leonov, V.; Chernyshov, V.; Klyazin, B.; Zakharova, Y. Translated from Sb. Rab. Khim. Istochnikam Toka; 6: 128-145(1971). 15p. (FSTC-HT--23-630-74). NTIS $3.25.
SILVER-ZINC BATTERIES;STORAGE;ANODES; CHEMICAL REACTIONS

2415 (AD/A--000246) PROCESSES DURING STORAGE OF CHARGED SILVER--CADMIUM (AG--CD) BATTERIES. Molotkova, E.N.; Lipunova, N.B. Translated from Sb. Rab. Khim. Istochnikam Toka; No. 6, 108-117(1971). 14p. (FSTC-HT--23-631-74). NTIS $3.25.
Changes of electrical characteristic of components after storage at 20° to 50°. SILVER-CADMIUM BATTERIES;STORAGE;ELECTRIC POTENTIAL; CHEMICAL COMPOSITION;GRIDS;ELECTROLYTES;BATTERY SEPARATORS;MEDIUM TEMPERATURE;CHEMICAL REACTION KINETICS

2416 (AD--781224) STUDY OF OPERATING MODES OF DIESEL LOCOMOTIVE ALKALINE STORAGE BATTERIES. Koshevoi, V.A. Translated by A.L. Peabody from Tr. Vses. Nauchno-Issled. Inst. Zheleznodorozhn. Transp. ; No. 429, 131-142(1971). 14p. (FSTC-HT--23-1858-73). NTIS $4.00.
IRON-NICKEL BATTERIES;OPERATION; ELECTROCHEMISTRY;MEDIUM TEMPERATURE;HEATING; BATTERY CHARGING;RELIABILITY;HYDROXIDES; PERFORMANCE;DIESEL ENGINES

2417 THERMODYNAMIC CHARACTERISTICS OF $PB^{2+}$ ION IN AN AQUEOUS SOLUTION. Vasil'ev, V.P.; Glavina, S.R. Elektrokhimiya; 7: No. 9, 1395(1971). (In Russian).
The standard potential and its temperature coefficient, entropy, enthalpy, and standard free energy for the $Pb^{2+}/Pb$ couple were determined. (RWR)

2418 EFFECT OF CARBONATE ON THE PERFORMANCE OF SEALED NICKEL--CADMIUM CELLS. Barney, D.L.; Catotti, A.J.; Pensabene, S.F. (General Electric Co., Gainesville, FL). pp 119-133 of Seventh symposium on research and development of non-mechanical and electrical power sources. Collins, D.H. (ed.). Newcastle upon Tyne, Eng.; Oriel Press (1971).
The presence of carbonate as an impurity in the electrolyte adversely affects performance. Poor voltage characteristics were believed due to reactions of $CO_3^{2-}$ at the positive electrode. Cadmium migration through the separator caused reduced cycle life. (RWR)

2419 LTIHIUM ALLOYS--CHLORINE BATTERY. II. CHARGE AND DISCHARGE REACTION AND DIFFUSION OF LITHIUM IN ALLOY AT NEGATIVE ELECTRODE OF THE LITHIUM ZINC ALLOY--CHLORINE SECONDARY BATTERY. Yoshizawa, S.; Takehara, Z.; Ito, Y.; Morimoto, S. (Kyoto Univ.). Denki Kagaku; 39: No. 12, 954-959(1971). (In Japanese).
The reactions at the negative electrode of a Li--Zn(liq)/LiCl--KCl molten salt/C--Cl cell were studied. The rate-determining step of the reaction was the diffusion of Li and K in the zinc alloy. The diffusion coefficient of lithium in anodic discharge was very high. (RWR)

2420 ELECTRON MICROSCOPY OF THE FORMATION OF LEAD SULFATE ON LEAD IN A LEAD--ACID CELL. Chiku, T.; Kojima, K. (Toyota Research and Development Lab., Nagoya, Japan). Denki Kagaku; 39: No. 10, 827-830(1971). (In Japanese).
Crystal growth occurred dendritically on the crystal surface planes of lead monocrystals during discharge. Deposit shape depended on the condition of discharge. The significance of the substrate is studied. (RWR)

2421 CHARGING PERFORMANCE OF OVER-DISCHARGED LEAD--ACID BATTERIES. Ninomiya, K.; Chiku, T. (Toyoto Central Research and Development Lab., Inc., Nagoya, Japan). Denki Kagaku; 39: No. 11, 882-887(1971). (In Japanese).
The conditions of the test for effects of overdischarge are set forth. Potentials and gas evolution rates were measured. It was found that, if the cell was recharged immediately after over-discharge, it was difficult to restore the discharge capacity of the positive electrode, while that of the negative electrode was not significantly decreased. If a period of time elapsed before recharging, it was the negative electrode which could not be restored,

while deterioration of the positive electrode was less marked. (RWR)

2422 CHARGING CHARACTERISTICS OF A SEALED-TYPE NICKEL--CADMIUM CELL. Park, Y.W.; Kin, C.W.; Jhon, M.S. (Korea Inst. of Science and Technology, Seoul). Daehan Hwahak Hwoejee; 15: No. 6, 347-352(1971). (In Korean).
Internal pressure and variations of electrode potentials were measured during charging. Polarization effects are discussed. A carbon active electrode functioned effectively as an oxygen-consuming electrode; internal pressure was kept below 200 mm Hg. (RWR)

2423 SPARKFREE CHEMICAL CURRENT SOURCES. Ziyatly, V.D. (Azerbaydzhan Inst. of Oil Chemistry, Baku, USSR). Izv. Vyssh. Uchebn. Zaved., Neft Gaz; 14: No. 10, 99-102(1971). (In Russian).
The terminals of storage batteries were deliberately short-circuited. The heating produced by the resulting currents was insufficient to cause ignition of the explosive mixtures of gases associated with the batteries. (RWR)

2424 WHAT IS HAPPENING TO THE LEAD STORAGE BATTERY. Nilsson, O. (AB Tudors Fabr., Nol, Sweden). Mod. Kemi; No. 12, 26-28(1971). (In Swedish).
The chemistry of the lead--acid battery, the dynamics of discharge, characteristics of the positive electrode, and alpha- and beta-lead oxide are briefly reviewed. (RWR)

2425 EFFECT OF RECHARGE ON THE CAPACITY OF THE SILVER ELECTRODE OF AN ALKALINE BATTERY OPERATING UNDER FORCED DISCHARGE CONDITIONS. Gaivoronskaya, N.P.; Dunaeva, T.I.; Ereiskaya, G.P.; Skalozubov, M.F. (Novocherk Politechnic Inst., USSR). Zh. Prikl. Khim.; 44: No. 12, 2666-2669(1971). (In Russian).
It was found that the loss in battery capacity was less when the recharge process was longer and more nearly complete. The decrease in capacity results from enlargement of the electrode surface, dispersion of the active mass, and exclusion of particles from the oxidizing process at potentials of the second anodic stage (oxidation to AgO). (RWR)

2426 LABORATORY ASSESSMENT OF THE SODIUM--SULFUR BATTERY. Sudworth, J.L.; Hames, M.D. (Research Dept. of the British Railway, Derby, Eng.). pp 227-244 of Seventh international symposium on power sources. III. Collins, D.H. (ed.). Newcastle upon Tyne, Eng.; Oriel Press (1971).
1.4 kWh. SODIUM-SULFUR BATTERIES;FABRICATION; TESTING;POLARIZATION;EFFICIENCY;ELECTRODES

2427 NICKEL--ZINC. PRACTICAL HIGH-ENERGY SECONDARY BATTERY. Kober, F.P.; Charkey, A. (Yardney Electric Corp., New York). pp 309-326 of Seventh international symposium on power sources. III. Collins, D.H. (ed.). Newcastle upon Tyne, Eng.; Oriel Press (1971).
The effects of charge mode, amount of overcharge, depth and rate of discharge, and cell construction on the capacity maintenance and cycle life of Ni/Zn cells were investigated. Decomposition of the separator was the most significant factor in decreased cell life; inorganic separators showed improved performance. (RWR)

2428 LEAD--SILVER OXIDE CELL. Collins, D.H. (Admiral Engineering Lab., West Drayton, Eng.). pp 551-565 of Power Sources. Vol. 3. Research and Development of Non Mechanical Electric Power Sources. Collins, D.H. (ed.). Newcastle upon Tyne, Eng.; Oriel Press (1971).
From 7. international symposium on power sources; Brighton, Eng. (1970).
Storage and charging characteristics were investigated. The cells could be stored for over nine years in an uncharged state; they yielded 70% of capacity after storage under temperate conditions for one year. A full charge requires about 60 hours, but 80% charge can be obtained in less than 20 hours. (RWR)

2429 EVALUATION OF FIRST SILVER ZINC BATTERIES USED IN DEEP SUBMERGENCE. Momsen, D.F.; Clerici, J.C. (Mare Island Naval Shipyard, Vallejo, CA). Mar. Technol. Soc. J.; 5: No. 2, 31-36(1971).
Deep submergence vehicles are today weight limited rather than volume limited. This automatically leads the designer to highest-energy-density-per-pound source readily available, and at present the prime candidate is the silver--zinc battery. This source offers an output of nearly 40 Wh/lb. In comparison to lead--acid batteries formerly used on the vehicle, this value represents about four times the power output per unit weight. Tradeoff studies on these values more than justified the ultimate selection of the silver--zinc battery for the submersible by increasing endurance within the allowable weight limits specified.

2430 ADVANCES IN ELECTROCHEMISTRY AND ELECTROCHEMICAL ENGINEERING. VOLUME 8. ELECTROCHEMICAL ENGINEERING. Tobias, C.W. (ed.). New York; Wiley-Interscience (1971). 406p.
Five papers cover solid-electrolyte batteries, thermal phenomena in fuel cells and batteries, the lead--acid cell, electrochemistry and application of propylene carbonate, and anodic oxidation of hydrocarbons and the hydrocarbon fuel cell. Selected individual papers are indexed separately.

2431 LEAD--ACID BATTERIES: THEIR INSTALLATION AND MAINTENANCE. Gupta, S.P. (Tata Iron and Steel Co., Ltd., Jamshedpur, India). TISCO; 18: No. 3, 105-117(1971).
Review article. LEAD-ACID BATTERIES; MAINTENANCE;OPERATION;REVIEWS

2432 STORAGE BATTERIES FOR ELECTRICALLY DRIVEN VEHICLES. Bode, H. Automobiltech. Z.; 72: No. 12, 432-436(Dec 1970). (In German).
The present state-of-the-art and future outlook of storage battery vehicles is described. Some unconventional electrochemical power generating cells are considered with a high efficiency rate using lithium, potassium, sulfur, zinc, and silver as plates and electrolytes. Fuel cells are also considered.

2433 SELF-DISCHARGE OF SILVER--ZINC STORAGE BATTERIES. Volkov, V.I.; Poroikova, V.S.; Kapustina, E.K. Elektrotekhnika; No. 10, 43-45(Oct 1970). (In Russian).
Results of experimental study are presented to conclude that the self-discharge of the batteries is essentially due to the properties of wrapping paper used in the manufacturing of the zinc cathodes.

2434 INTERNAL ALTERNATING CURRENT RESISTANCE

OF STORAGE BATTERIES. Bayunov, V.V.; Dasoyan, M.A. Elektrotekhnika; No. 10, 45-48(Oct 1970). (In Russian).
A method is described how to calculate the internal resistance of large batteries from the known data on small batteries.

2435 MODERN MAINTENANCE METHODS ASSURE DEPENDABLE BATTERY POWER. Baker, C.A. Jr. (Lead Industries Association, New York). Electr. Constr. Maint.; 69: No. 9, 116-118(Sep 1970).
A preventive maintenance program for lead--acid batteries for powering industrial trucks is described. The program includes charging methods, maintenance and test techniques, and cleaning procedures.

2436 FLOAT BEHAVIOR OF THE LEAD--ACID BATTERY SYSTEM. Milner, P.C. Bell Syst. Tech. J.; 49: No. 7, 1321-1334(Sep 1970).
The requirements for satisfactory float operation of lead--acid batteries are discussed, and behavior during float is analyzed in terms of the kinetic parameters which characterize the electrochemical processes occurring in the overcharge region. Knowledge of these parameters may be used to estimate whether adequate battery maintenance can be expected under specified float conditions.

2437 ELECTROCHEMICAL CHARACTERIZATION OF THE BELL SYSTEM BATTERY. FIELD TRIALS OF THE BATTERY. O'Sullivan, T.D.; Biagetti, R.V.; Weeks, M.C. Bell Syst. Tech. J.; 49: No. 7, 1335-1358(Sep 1970).
The electrochemical characteristics of pure lead circular grids, pasted plates, and separators were studied individually, and then extrapolated to encompass a full battery. Field trials have confirmed the laboratory tests and have shown that the battery has excellent capacity and float characteristics which ensure that this capacity will be retained for long periods of time.

2438 BATTERIES AND FUEL CELLS. Barak, M. Proc. Inst. Electr. Eng. (London); 117, Special Issue: vp.(Aug 1970).
48 references. SODIUM-SULFUR BATTERIES;ZINC-AIR BATTERIES;METAL-GAS BATTERIES;ELECTRIC BATTERIES;FUEL CELLS;FABRICATION;PERFORMANCE; REVIEWS

2439 EFFECT OF THE DESIGN PARAMETERS ON THE CAPACITIVE CHARACTERISTICS OF THE SILVER ZINC STORAGE BATTERIES WHEN CHARGED BY ASYMMETRICAL ALTERNATING CURRENT. Bayunov, V.V.; Dasoyan, M.A. Elektrotekhnika; No. 8, 50-51(Aug 1970). (In Russian).
SILVER-ZINC BATTERIES;ELECTRICAL PROPERTIES; BATTERY CHARGING;ALTERNATING CURRENT;DESIGN; PERFORMANCE

2440 NEW BATTERIES USE ZINC--AIR COUPLE. Peach, N. Power (N.Y.); 114: No. 8, 44(Aug 1970).
A rechargeable battery system has a high energy density making it suitable for a variety of motive power applications.

2441 EFFECT OF THE DESIGN PARAMETERS ON THE CAPACITIVE CHARACTERISTICS OF THE SILVER--ZINC STORAGE BATTERIES WHEN CHARGED BY ASYMMETRICAL ALTERNATING CURRENT. Bayunov, V.V.; Dasoyan, M.A. Elektrotekhnika; No. 8, 50-51(Aug 1970). (In Russian).
SILVER-ZINC BATTERIES;DESIGN;ALTERNATING CURRENT;BATTERY CHARGING

2442 ELECTROCHEMICAL BEHAVIOR OF LEAD IN SULFURIC ACID SOLUTIONS. Milyutin, N.N.; Ozhiganova, N.N. J. Appl. Chem. USSR (Engl. Transl.); 43: No. 8, 1704-1709(Aug 1970).
Translated from Zh. Prikl. Khim.; 43: No. 8, 1686-1693(Aug 1970).
The nature and mechanism of processes occurring during anodic oxidation of lead are of interest because lead and alloys are widely used in chemical industry, and especially in production of electric storage batteries. During anodic polarization of lead in sulfuric acid solution it becomes coated with salt layer. At potentials of 0.25 V and higher, the main reaction of lead sulfate formation is accompanied by formation of lead oxide. At 1.8 V in a solution of pH 0, bivalent lead ions are oxidized to the peroxide. The potential of this conversion varies steadily with the solution pH. Oxygen of water is oxidized at the surface coated with lead dioxide. The course of the anodic process of lead oxidation is consistent with conclusions drawn from the equilibirum diagram for the system lead--water--sulfuric acid.

2443 THERMODYNAMIC CONSIDERATIONS OF THE VARIOUS CONTRIBUTIONS TO OVERPOTENTIAL. I AND II. Guidelli, R. (Istituto di Chimica Analitica, Firenze, Italy). Trans. Faraday Soc.; 66: No. 469, 1185-1202(May 1970).
The author considered the various types of overpotential (ohmic, diffusion, charge-transfer, reaction overpotential) which are encountered when an electric current flows through a galvanic cell. A relation among overpotential, current density, and entropy production in local form is derived. The relation is employed in order to define charge-transfer, reaction, and diffusion overpotential in a rigorous way. On the basis of the definition of charge-transfer overpotential, the Tafel equation is derived without recourse to the formal separation of the standard-free energy change relating to the electrode process into a potential-dependent and a potential-independent part.

2444 CHARACTERISTICS OF SEALED NICKEL--CADMIUM RECHARGEABLE BATTERIES ''PANANICA''. Oda, S.; Ito, Z.; Mukunoki, J.; Ito, A. Natl. Tech. Rep. (Matsushita Electr. Ind. Co., Osaka); 16: No. 2, 238-245(Apr 1970). (In Japanese).
The sealed nickel--cadmium battery has recently been applied as a power source for various cordless electrical appliances. The improvement of the procedure for making electrodes as well as electrode structure made possible the development of a high-quality cylindrical sealed nickel--cadmium battery which is capable of high-rate discharge with safety and high reliability. Various characteristics, such as high-rate discharge and good temperature characteristics, are described. A newly developed rapid charging system is discussed, which can reduce the time required for charging from about 16 hr to 5 hr.

2445 REVERSIBILITY ON CHARGE AND DISCHARGE OF MANGANESE DIOXIDE ELECTRODE IN ALKALINE ELECTROLYTE. Ohira, T.; Ogawa, H. Natl. Tech. Rep. (Matsushita Electr. Ind. Co., Osaka); 16: No. 2, 209-216(Apr 1970). (In Japanese).
The effect of discharge depth of manganese dioxide on its reversibility in charge and discharge cycle was studied by x-ray

diffraction, charge and discharge curves. The sample electrode was prepared by mixing and molding powders of electrolytic manganese dioxide and graphite. As a result, it was found that the manganese dioxide can be regenerated by charging to almost the same state as before discharge, when it was discharged to less than 40 percent of its theoretical capacity. This was true only for the discharge of the first cycle; and in case this charge and discharge cycle was repeated, if the discharge is limited to 20 percent of its theoretical capacity, at least 35 cycles can be obtained. The reversibility of manganese dioxide electrode was improved by full charge; however, during overcharging there are a few problems, such as the lack of adhesion of the positive active material on the plate, resulting in shedding of active materials and failure of separator.

2446 LEAD--ACID BATTERY FOR CORDLESS ELECTRICAL APPLIANCES. Ichihara, H.; Watanabe, A.; Sunaoshi, M.; Yamada, Y. Natl. Tech. Rep. (Matsushita Electr. Ind. Co., Osaka); 16: No. 2, 223-229(Apr 1970). (In Japanese).

To meet the requirements for economical operation of cordless appliances, a compact lead--acid battery was developed which can be properly used as a power source. Because primary batteries like Leclanche dry cells have poor voltage stability and the nickel--cadmium battery is expensive, these do not seem to be appropriate as a power source. Several features of this lead--acid battery can be stated. Shelf life was largely improved by the adoption of lead--cadmium alloy. The use of a gel-type electrolyte made it possible for this type battery to be used in any position without electrolyte leakage. The adoption of a new type charging circuit effectively protects batteries against failure due to overcharge, because this circuit controls gas evolution during charging. As a result, maintenance-free battery operation was realized.

2447 CHARGE--DISCHARGE CHARACTERISTICS OF SILVER OXIDE--ZINC ALKALINE STORAGE BATTERY. Ogawa, H.; Ohira, T. Natl. Tech. Rep. (Matsushita Electr. Ind. Co., Osaka); 16: No. 2, 257-268(Apr 1970). (In Japanese).

This report describes a small-size, light-weight, and highly reliable power supply unit for the sounding rocket. A wide variety of performance tests were conducted by studying the effect of various conditions such as upper cut-off voltage of charger, charging time, ambient temperature, discharge rate, operating attitude, standing time after charge, shock and/or vibration. It was confirmed that this battery can be safely operated for at least 10 cycles in very severe condition, which is the proper requirement for the power supply unit. By combining this battery and regulator, the rocket was successfully launched.

2448 BATTERIES FOR BATTERY-POWERED VEHICLES. Witte, E. Foerdern Heben; 20: No. 4, 198-202(Mar 1970). (In German).

Electric vehicles are predominantly powered by lead batteries with armored plate cells or sometimes with grid plate cells. In special applications, steel batteries of nickel--iron or nickel--cadmium construction with tubular plates are employed. Specific data such as service life, care, space requirement and initial costs of different models are compared, and guidelines for correct usage given.

2449 ZINC HALIDE STORAGE BATTERIES. De Rossi, M. (Univ., Rome); Berardelli, M.L.; Pistoia, G.; Scrasati, B. Elettrotecnica; 57: No. 2, 84-92(Feb 1970). (In Italian).

Research carried out in order to develop a new type of zinc halide storage battery is reported. In particular, attention has been focused on a Zn--$Br_2$ system with recirculating aqueous electrolyte. Performances and electrical characteristics of the new element are also reported.

2450 SOLID-STATE ELECTRIC BATTERIES. De Rossi, M. (Univ., Rome); Scrosati, B. Elettrotecnica; 57: No. 1, 12-23(Jan 1970). (In Italian).

The research performed at the Instituto Elettrotecnico of the University of Rome on solid-state galvanic cells is reported. Particularly, performance and characteristics of low internal resistance, rechargeable solid-state cells are described.

2451 ELECTRICAL CHARACTERISTICS OF NICKEL--ZINC SECONDARY CELLS. Charlip, S.; Lerner, S. (Battery and Power Sources Div., Gulton Industries, Inc., Metuchen, NJ). pp 5-6 to 5-8 of Energy 70, Proceedings. Intersociety Energy Conversion Engineering Conference. Volume 1. Hinsdale, IL; American Nuclear Society (1970).

From 5. annual intersociety energy conversion engineering conference; Las Vegas, Nevada, USA (21 Sep 1970).

NICKEL-ZINC BATTERIES;DESIGN;ZINC;ELECTRODES; PERFORMANCE;ECONOMICS;ELECTRIC POTENTIAL; ELECTRICAL PROPERTIES;TESTING;LIFETIME

2452 NICKEL--CADMIUM BATTERY EVALUATION FOR APOLLO TELESCOPE MOUNT APPLICATION. Kirsch, W.W.; Shikoh, A. (Space Support Div., Sperry Rand Corp., Huntsville, AL). pp 5-21 to 5-27 of Energy 70, Proceedings. Intersociety Energy Conversion Engineering Conference. Volume 1. Hinsdale, IL; American Nuclear Society (1970).

From 5. annual intersociety energy conversion engineering conference; Las Vegas, Nevada, USA (21 Sep 1970).

NICKEL-CADMIUM BATTERIES;SATELLITES;ELECTRIC POTENTIAL;BATTERY CHARGING;PERFORMANCE TESTING; APOLLO PROJECT

2453 ELECTROCHEMICAL CELL EQUIVALENT CIRCUIT FOR STORAGE BATTERY/POWER SYSTEM CALCULATIONS BY DIGITAL COMPUTER. Zimmerman, H.G. (Lockheed Missiles and Space Co., Sunnyvale, CA); Peterson, R.G. (Lockheed Aircraft Corp., Burbank, CA). pp 5-33 to 5-39 of Energy 70, Proceedings. Intersociety Energy Conversion Engineering Conference. Volume 1. Hinsdale, IL; American Nuclear Society (1970).

From 5. annual intersociety energy conversion engineering conference; Las Vegas, Nevada, USA (21 Sep 1970).

EQUIVALENT CIRCUITS;ELECTRIC BATTERIES; SIMULATION;DIGITAL COMPUTERS;SATELLITES;DESIGN; PERFORMANCE

2454 POWER SYSTEM EVALUATOR OPERATIONAL CHARACTERISTICS. Breeskin, S.D. (Advance Secondary Power Systems Branch, Research and Development, McDonnell Douglas Astronautics Co. - Western Div., Huntington Beach, CA). pp 5-40 to 5-45 of Energy 70, Proceedings. Intersociety Energy Conversion Engineering Conference. Volume 1. Hinsdale, IL; American Nuclear Society (1970).

From 5. annual intersociety energy conversion engineering conference; Las Vegas, Nevada, USA (21 Sep 1970).

NICKEL-CADMIUM BATTERIES;SPACE VEHICLES;

POWER SUPPLIES;PERFORMANCE TESTING

2455 NICKEL--CADMIUM BATTERIES FOR THE ORBITING ASTRONOMICAL OBSERVATORY SPACECRAFT-II (OAO). Ford, F.E.; Henningan, T.J. (Goddard Space Flight Center, Greenbelt, MD). pp 1-4 of 24th power sources symposium. Red Bank, NJ; PSC Publications Committee (1970).
From 24. power sources symposium; Fort Monmouth, NJ (19 May 1970).
Increasing cell voltage with life found to be due to high precharge in negative plates; method for alleviating problem. NICKEL-CADMIUM BATTERIES;ELECTRIC POTENTIAL;PERFORMANCE; TESTING;LIFETIME;SATELLITES;FABRICATION

2456 DESIGN, TESTING, AND FLIGHT PERFORMANCE OF THE MARINER MARS 1969 SPACECRAFT BATTERIES. Krause, S.J. (Jet Propulsion Lab., Pasadena, CA). pp 7-9 of 24th power sources symposium. Red Bank, NJ; PSC Publications Committee (1970).
From 24. power sources symposium; Fort Monmouth, NJ (19 May 1970).
SILVER-ZINC BATTERIES;DESIGN;TESTING; PERFORMANCE;MARS PLANET;SPACE VEHICLES;HYDROGEN; ELECTRIC POTENTIAL

2457 CHARGE ACCEPTANCE OF THE LEAD CELL AT VARIOUS CHARGING RATES AND TEMPERATURES. Peters, K.; Harrison, A.I.; Durant, W.H. (Electric Power Storage Ltd., Swinton, Eng.). pp 1-16 of Power sources 2. Research and development in non-mechanical electrical power sources. Collins, D.H. (ed.). Oxford; Pergamon Press Ltd. (1970).
From 6. international symposium on power sources 2; Brighton, Eng. (Sep 1968).
0 to 40°C. LEAD-ACID BATTERIES;BATTERY CHARGING;GASES;TEMPERATURE DEPENDENCE;TIME DEPENDENCE;EFFICIENCY;ELECTRODES;PERSULFURIC ACID;MEDIUM TEMPERATURE;ELECTRIC-POWERED VEHICLES;ELECTROCHEMISTRY;CHEMICAL REACTIONS

2458 EFFECT OF TEMPERATURE AND CURRENT DENSITY ON THE UTILIZATION OF LEAD AND LEAD OXIDE ELECTRODES. Berndt, D. (Varta Forschungs und Entwicklungszentrum, Kelkheim, Ger.). pp 17-31 of Power sources 2. Research and development in non-mechanical electrical power sources. Collins, D.H. (ed.). Oxford; Pergamon Press Ltd. (1970).
From 6. international symposium on power sources 2; Brighton, Eng. (Sep 1968).
-50 to +40°C. CHEMICAL REACTION KINETICS; LEAD-ACID BATTERIES;ELECTRODES;TEMPERATURE DEPENDENCE;CURRENT DENSITY;PLATES;POROSITY; DIFFUSION;CRYSTALLIZATION;ELECTRIC POTENTIAL; POLARIZATION;ELECTROCHEMISTRY;CHEMICAL REACTIONS;MASS TRANSFER;LOW TEMPERATURE;MEDIUM TEMPERATURE;TIME DEPENDENCE

2459 SPECIFIC PROPERTIES OF SMALL CLOSED LEAD ACCUMULATORS USING AN IMMOBILIZED ELECTROLYTE. Eberts, K. (Accumulatorenfabrik Sonnenschein, Buedingen, Ger.). pp 69-92 of Power sources 2. Research and development in non-mechanical power sources. Collins, D.H. (ed.). Oxford; Pergamon Press Ltd. (1970).
From 6. international symposium on power sources 2; Brighton, Eng. (Sep 1968).
LEAD-ACID BATTERIES;ELECTROLYTES;BATTERY CHARGING;PERFORMANCE;VALVES;TEMPERATURE DEPENDENCE;COMPARATIVE EVALUATIONS;ELECTRIC CONDUCTIVITY;COST;TRANSISTORS;ELECTRONIC CIRCUITS;MEDIUM TEMPERATURE;LOW TEMPERATURE

2460 PARAMETRIC CHARGE STUDIES FOR AEROSPACE NICKEL--CADMIUM BATTERIES. Preusse, K.E.; Shair, R.C.; Betz, F.E. (Gulton Industries, Inc., Metuchen, NJ). pp 199-212 of Power sources 2. Research and development in non-mechanical power sources. Collins, D.H. (ed.). Oxford; Pergamon Press Ltd. (1970).
From 6. international symposium on power sources 2; Brighton, Eng. (Sep 1968).
NICKEL-CADMIUM BATTERIES;BATTERY CHARGING; CONTROL;SATELLITES;ELECTRIC POTENTIAL; PERFORMANCE;MEDIUM TEMPERATURE

2461 COMPUTER USE IN AUTOMATIC DATA ACQUISITION SYSTEMS FOR BATTERY TESTING. Newton, D.O. (San Francisco Bay Naval Shipyard, Vallejo, CA). pp 213-230 of Power sources 2. Research and development in non-mechanical power sources. Collins, D.H. (ed.). Oxford; Pergamon Press Ltd. (1970).
From 6. international symposium on power sources 2; Brighton, Eng. (Sep 1968).
DATA ACQUISITION SYSTEMS;ON-LINE MEASUREMENT SYSTEMS;TESTING;ELECTRIC BATTERIES;LOGIC CIRCUITS;COMPUTER CODES;PROGRAMMING

2462 PERSONALITY OF NICKEL--CADMIUM BATTERIES. Clark, C.T. New York; Society of Automotive Engineers, Inc. (1970). 3p.
Fading in nicad batteries can be prevented by using a higher than normal charging voltage. In order to prevent or reduce excessive gassing, a compromise voltage of 28 to 28.5 V is optimal. Rejuvenation of faded batteries is possible by totally discharging and then recharging by the constant current method. In order to prevent excessive gassing due to thermal overwork, batteries should be installed in ambients that do not exceed 160 F.

2463 AIR--ZINC ACCUMULATOR. Vignaud, R. Entropie; No. 33, 13-20(1970). (In French).
A description of an air/zinc battery structure and its components is given together with the present properties and possibilities for charging and discharging. Study of the specific energy shows that it should be above 100 Wh/kg.

2464 CAPSULATING ENERGY SYSTEMS FOR SMALL SUBMERSIBLES. Anderson, A.G.; Wright, C.P.; Newman, J.P. pp 193-202 of Second annual offshore technology conference. Volume I. Dallas; Offshore Technology Conference (1970).
From Offshore technology conference; Houston, Texas, USA (22 Apr 1970).
See CONF-700464--P1.
The primary purpose of the paper is to present operating and design experience which Perry Oceanographics has had so that it may be recorded for the technical community. Underwater power application imposes constraints which require unique design solutions to problems of power sources. This paper will discuss experiences with different power sources designed to go to various depths. Submersible battery pod designs will be discussed in some detail. A diesel pod design, used directly with a small submersible, will be reviewed. The experiences of encapsulating a fuel cell and operating it in conjunction with an underwater lab will be reported. Implications of these power sources on the future will be discussed.

2465 EFFECT OF CONCENTRATION OF CARBONATES IN THE ELECTROLYTE ON ELECTRICAL CHARACTERISTICS OF SILVER--CADMIUM BATTERIES. Andreeva, G.P.; Vorob'eva, G.B.; Karaeva, N.V. Sb. Rab. Khim. Istochnikam Toka; No. 5, 144-157(1970). (In

Russian).
The effect of carbonates building up in the electrolyte during operation of a Ag/Cd battery was studied. The role of $CO_3^{2-}$ and $OH^-$ ions is discussed. (RWR)

2466 EFFECT OF PRESSURE ON DISCHARGE CHARACTERISTICS OF A NEGATIVE ELECTRODE. Syrovegina, A.P.; Dasoyan, M.A.; Lashchagin, I.V.; Emel'yantseva, L.N. Sb. Rab. Khim. Istochnikam Toka; No. 5, 31-37(1970). (In Russian).
The effect of 200 atmospheres pressure on the discharge characteristics of a negative lead electrode was investigated. Electrodes were 1.4 to 3.6 mm thick; current densities ranged from 4 to 96 $mA/cm^2$. The pressure had a positive effect which increased with increased electrode thickness and current density. (RWR)

2467 MECHANISM OF THE EFFECT OF ORGANIC ADDITIVES ON THE OPERATION OF A NEGATIVE LEAD BATTERY ELECTRODE. Aguf, I.A.; Dasoyan, M.A.; Ivanenko, L.A.; Parshikova, E.V.; Solov'eva, K.M. Sb. Rab. Khim. Istochnikam Toka; No. 5, 21-30(1970). (In Russian).
The effects on crystallization of lead sulfate, electrocrystallization, and anodic passivation of lead were studied for a number of organic depassivators and corrosion inhibitors. Surfactants showed no appreciable effect. The inhibitors α-hydroxynaphthoic acid and α-nitrosonaphthol showed some effects on crystallization. Organic additives caused a change in the capacity of the lead electrode and size of $PbSO_4$ crystals; the effects are associated with the adsorption of substances on lead. (RWR)

2468 USE OF MAGNETICALLY TREATED SULFURIC ACID SOLUTIONS IN THE PRODUCTION OF LEAD STORAGE BATTERIES. Skalozubov, M.F.; Molchan, A.G. Tr. Novocherkassk. Politekh. Inst.; No. 217, 61-63(1970). (In Russian).
Magnetically treated sulfuric acid solutions were used to prepare pastes for the positive electrodes of lead--acid batteries. Improved performances of these batteries are discussed. (RWR)

2469 IMPEDANCE OF GALVANIC CELLS. XXVIII. Sluyters-Rehbach, M. (State Univ., Utrecht); Sluyters, J.H. J. Electroanal. Chem. Interfacial Electrochem.; 23: No. 3, 457-474(Dec 1969).
ELECTRIC BATTERIES;IMPEDANCE;CHEMICAL REACTIONS;ELECTRODES;MATHEMATICAL MODELS; ELECTROCHEMISTRY

2470 DIFFERENTIAL CAPACITANCE AND CYCLIC VOLTAMETRIC STUDIES ON SMOOTH LEAD IN $H_2SO_4$ SOLUTIONS. Sharpe, T.F. (General Motors Corp., Warren, MI). J. Electrochem. Soc.; 116: No. 12, 1639-1642(Dec 1969).
One method for studying adsorption at an electrode surface is to obtain curves showing the relationship between differential capacitance and electrode potential. The purpose of this work was to determine the extent to which organic additives, having known degrees of expander activity, alter the shape of such curves obtained with smooth lead electrodes in $H_2SO_4$ solutions. Also included in this study were cyclic voltametric experiments to measure the electric current that flowed throughout the potential range at which the differential capacitance measurements were made. The adsorption of an organic expander at a smooth lead electrode is undoubtedly distributed differently from that at a lead--acid battery negative plate. Because of its porous nature, the negative plate possesses reaction sites having a wide range of activity. Unlike the smooth lead electrode, where the adsorption may be distributed over most of the electrode surface, adsorption at the negative plate may occur only at the most active reaction sites.

2471 EXCHANGE REACTION AT POLYCRYSTALLINE CADMIUM ELECTRODES. I. Hampson, N.A. (Univ. of Tech., Leicestershire, Eng.); Latham, R.J.; Larkin, D. J. Electroanal. Chem. Interfacial Electrochem.; 23: No. 2, 211-218(Nov 1969).
NICKEL-CADMIUM BATTERIES;ANODES;CHEMICAL REACTIONS;CHARGE EXCHANGE;ELECTROLYTES; PERCHLORATES;HYDROXIDES

2472 CYLINDRICAL SHAPE DOUBLES BATTERY LIFE. Bell Lab. Rec.; 47: No. 9, 308-309(Oct 1969).
LEAD-ACID BATTERIES;CYLINDRICAL CONFIGURATION;LIFETIME;PERFORMANCE;DESIGN

2473 IMPEDANCE OF GALVANIC CELLS. XXVI. Dekker, B.G. (State Univ., Utrecht); Sluyters-Rehbach, M.; Sluyters, J.H. J. Electroanal. Chem. Interfacial Electrochem.; 23: No. 1, 9-16(Oct 1969).
ELECTRIC BATTERIES;ELECTRIC CONDUCTIVITY; ELECTROCHEMISTRY;IMPEDANCE

2474 IMPEDANCE OF GALVANIC CELLS. XXVII. Dekker, B.G. (State Univ., Utrecht); Sluyters-Rehbach, M.; Sluyters, J.H. J. Electroanal. Chem. Interfacial Electrochem.; 23: No. 1, 17-22(Oct 1969).
ELECTRIC BATTERIES;ELECTRIC CONDUCTIVITY; ELECTROCHEMISTRY;MERCURY;IMPEDANCE

2475 EFFECT OF HIGH PRESSURE ON THE VOLTAGE AND CURRENT OUTPUT OF SILVER OXIDE--ZINC AND MERCURY OXIDE--ZINC MINIATURE BATTERIES. Andersen, T.N. (Univ. of Utah, Salt Lake City); Miner, B.A.; Ghandehari, M.H.; Brodd, R.J.; Eyring, H. J. Electrochem. Soc.; 116: No. 10, 1342-1347(Oct 1969).
SILVER-ZINC BATTERIES;METAL-METAL OXIDE BATTERIES;COMPARATIVE EVALUATIONS;PERFORMANCE; PRESSURE DEPENDENCE;ZINC;MERCURY OXIDES; ELECTRIC POTENTIAL;ELECTRIC CURRENTS

2476 INTRINSIC CHARGING RATE CAPABILITY OF THE CADMIUM ANODE. Bro, P. (Mallory and Co., Inc., Burlington, MA); Marincic, N. J. Electrochem. Soc.; 116: No. 9, 1176-1178(Sep 1969).
Cd/AgCl cells in Cd chloride solution capable of fast charging. SILVER-CADMIUM BATTERIES;ANODES;CADMIUM;SILVER CHLORIDES; BATTERY CHARGING;HYDROGEN;CADMIUM CHLORIDES

2477 HEAT GENERATION IN SEALED BATTERIES. Gross, S. (Boeing Co., Seattle). Energy Convers.; 9: No. 2, 55-62(Jun 1969).
NICKEL-CADMIUM BATTERIES;SILVER-CADMIUM BATTERIES;SILVER-ZINC BATTERIES;HEATING; THERMODYNAMIC MODEL;FORECASTING

2478 LEAK TESTING OF ALKALINE BATTERY CELLS. Moses, A.J. (Hughes Aircraft Co., Los Angeles). Non-Destr. Test. (Guildford, Engl.); 2: No. 2, 109-110(May 1969).
ELECTRIC BATTERIES;SEALS;PERFORMANCE TESTING; LEAK DETECTORS;HYDROXIDES;LEAK TESTING

2479 STATISTICAL STUDIES OF RECHARGEABLE BATTERY SYSTEMS. Elder, J.P. (Texas Instruments Inc., Attleboro, MA); Jost, E.M. J. Electrochem. Soc.; 116: No. 5, 687-693(May 1969).
NICKEL-CADMIUM BATTERIES;PERFORMANCE; OPTIMIZATION;STATISTICS

2480 BATTERY CARE AND MAINTENANCE. Hensler, J.F. Min. Congr. J.; 55: No. 4, 73-77(Apr 1969).
ELECTRIC BATTERIES;MAINTENANCE;ELECTRIC-POWERED VEHICLES;MINING EQUIPMENT

2481 CONCENTRATION CELL AS ELECTRIC POWER GENERATOR. Lechowski, L. Przegl. Elektrotech.; 45: No. 3, 130-132(Mar 1969). (In Polish).
ELECTRIC BATTERIES;THERMODYNAMIC PROPERTIES; ELECTROLYTES;WATER;PERFORMANCE TESTING; EFFICIENCY;ELECTRICAL PROPERTIES

2482 SECONDARY BATTERIES (ACID AND ALKALINE). I. London; British Standards Institution (Mar 1969). 13p.
ELECTRIC BATTERIES;SPECIFICATIONS;STANDARDS; PERFORMANCE TESTING;DESIGN;AIRCRAFT;HYDROXIDES; LEAD-ACID BATTERIES

2483 SECONDARY CELLS WITH LITHIUM ANODES AND IMMOBILIZED FUSED-SALT ELECTROLYTES. Shimotake, H. (Argonne National Lab., IL); Rogers, G.L.; Cairns, E.J. Ind. Eng. Chem., Process Des. Dev.; 8: No. 1, 51-56(Jan 1969).
Li/Bi and Li/Te. LITHIUM;ANODES;BISMUTH; TELLURIUM;CATHODES;POWER DENSITY;ELECTROLYTES; BATTERY CHARGING;ELECTRIC CONDUCTIVITY; PERFORMANCE;METAL-NONMETAL BATTERIES;ENERGY STORAGE;ELECTRIC-POWERED VEHICLES;BATTERY PASTE

2484 DESIGN DESCRIPTION OF THE POWER SUPPLY SUBSYSTEM FOR THE TD1/TD2 SATELLITES. Rainforth, J.H.P. (Hawker Siddeley Dynamics, Ltd., Space Div., Stevenage, Herts, England). J. Br. Interplanet. Soc.; 22: 157-73(1969).
From 8. European Space Symposium on Technological Aspects of Scientific Satellites; Venice, Italy (27-29 May 1968).
RELIABILITY;SATELLITES;SPACE VEHICLES;DESIGN; SPACECRAFT POWER SUPPLIES;ELECTRIC BATTERIES; SOLAR CELL ARRAYS;PERFORMANCE

2485 OPTIMIZATION OF BATTERY SUBSYSTEMS FOR EARTH SATELLITE LIFETIMES OF GREATER THAN 5 YEARS. Koslover, M. (TRW Systems Group, Electric Power Systems, Space Vehicles Div., Redondo Beach, CA). pp 61-73 of Proceedings of the 4th Intersociety Energy Conversion Engineering Conference, September 22-26, 1969, Washington, DC. New York; American Institute of Chemical Engineers (1969).
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SATELLITES;OPTIMIZATION;LIFETIME;RELIABILITY; NICKEL-CADMIUM BATTERIES;PERFORMANCE

2486 PARAMETRIC CHARGE STUDIES FOR AEROSPACE NICKEL--CADMIUM BATTERIES. Preusse, K.E.; Shair, R.C.; Betz, F.E.; Sylvia, J. (Gulton Industries, Inc., Metuchen, NJ). pp 705-9 of Proceedings of the 4th Intersociety Energy Conversion Engineering Conference, September 22-26, 1969, Washington, DC. New York; American Institute of Chemical Engineers (1969).
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2925 (AD--699589) STUDY OF THE COMPOSITION OF NONAQUEOUS SOLUTIONS OF POTENTIAL USE IN HIGH ENERGY DENSITY BATTERIES. FINAL REPORT, 1 SEP 1966-31 AUG 1969. Butler, J.N.; Cogley, D.R.; Synnott, J.C.; Holleck, G. (Tyco Labs., Inc., Waltham, Mass. (USA)). Sep 1969. Contract AF 19(628)-6131. 304p. (C--648; AFCRL--69-0470). NTIS.
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2926 (AD--702938) IONIC CONDUCTION IN BETA-ALUMINA. INTERIM TECHNICAL REPORT NO. 6, 8 FEB--8 AUG 1969. Hsueh, L. (California Univ., Los Angeles (USA). School of Engineering and Applied Science). 1969. Contract DA-44-009-AMC-1661(T). 31p. (UCLA--69-68). NTIS $3.00.
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2927 (AD--703842) ELECTRODE REACTIONS IN MOLTEN SODIUM NITRATE--BARIUM NITRATE EUTECTIC AT 350 DEGREES C. Behl, W.K. (Army Electronics Command, Fort Monmouth, N.J. (USA)). Feb 1970. 33p. (ECOM--3232). NTIS $6.00.

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2928 (AD--706596) ANODIC BEHAVIOR OF ZINC ELECTRODES IN POTASSIUM HYDROXIDE ELECTROLYTES. TECHNICAL REPORT. Hull, M.N.; Ellison, J.E.; Toni, J.E. (Army Electronics Command, Fort Monmouth, N.J. (USA)). Apr 1970. 14p. (ECOM--3255). NTIS.
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2929 (AD--709272) SULFUR ELECTRODE. Coleman, J.R.; Bates, M.W. (Defence Research Establishment, Ottawa, Ontario (Canada)). 1969. 14p. (DREO--549).
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2930 (AD--710249) USE OF DIRECT-CURRENT VOLTAGE CONVERTER TO MAINTAIN CONSTANT 27.5-VOLT TERMINAL VOLTAGE FROM LEAD--ACID BATTERY POWER SUPPLY. Lange, G.M. (Army Mobility Equipment Research and Development Center, Fort Belvoir, Va. (USA)). Jun 1970. 31p. (USAMERDC--1981). NTIS.
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2931 (AD--714680) NONAQUEOUS ELECTROLYTE SYSTEMS: IONIC TRANSPORT IN NONAQUEOUS MEDIA. INTERIM TECHNICAL REPORT NO. 7. Hseuh, L.; Nelson, A.G.; Mirza, Z.I.; Bennion, D.N. (California Univ., Los Angeles (USA). School of Engineering and Applied Science). Jul 1970. 52p. (UCLA--ENG-7064). NTIS $3.00.
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2932 (AD--715707) LOW-COST OXYGEN ELECTRODES. RESEARCH AND DEVELOPMENT TECHNICAL REPORT. Wynn, J.E. (Army Electronics Command, Fort Monmouth, N.J. (USA)). Nov 1970. 35p. (ECOM--3354). NTIS.
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2933 (AD--715707) LOW COST OXYGEN ELECTRODES. RESEARCH AND DEVELOPMENT TECHNICAL REPORT. Wynn, J.E. (Army Electronics Labs., Fort Monmouth, N.J. (USA)). Nov 1970. 35p. (ECOM--3354). NTIS $3.00.
Mixed transition metal oxide catalysts. FUEL CELLS;ZINC-AIR BATTERIES;CATHODES;CATALYSTS; TRANSITION ELEMENTS;OXIDES;PERFORMANCE

2934 (AD--720600) ACTIVE ENERGY STORAGE MATERIALS FOR INTEGRATED CELL STACKS. TECHNICAL REPORT, 1 JUL 1970-15 JAN 1971. Fishwick, J.H.; Dremann, C.E. (Foote Mineral Co., Exton, Pa. (USA)). Mar 1971. Contract DAAB07-70-C-0173. 31p. (ECOM--0173-1). NTIS.
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2935 (AD--726607) LITHIUM BATTERY DEVELOPMENT. ANNUAL REPORT NO. 3, 1 APRIL 1970--31 MARCH 1971. Semones, D.E.; McCallum, J. (Battelle Columbus Labs., Ohio (USA)). Jun 1971. 81p. NTIS $3.00.
Research on inorganic compounds for use as positive electrodes in a rechargeable lithium battery is described. First, desired characteristics of the candidate electrode materials were considered, including theoretical voltages and idealized weight relationships and, therefore, the maximum watt-hours per pound that could be expected. Two dozen separate compounds were considered in this preliminary analysis from among seven general classes of inorganic compounds that included the metal salts of carbonates, cyanides, cyanates, thiocyanates, hydroxides, sulfides, and methoxides. Second, electrolytes to be used in combination with the candidate electrode compound were developed. One prerequisite for rechargeability in the electrolyte development was the presence of an anion common to both the positive electrode compound and to the electrolyte solute. An electrolyte resistivity lower than 1000 ohm-cm also was sought in these studies as well as stability of the electrolyte with the positive electrode compound and with lithium.

2936 (AD--728431) CYCLING ANODIC COATINGS ON PURE AND ANTIMONIAL LEAD IN $H_2SO_4$. Burbank, J. (Naval Research Lab., Washington, D.C. (USA)). 1971. 23p. NTIS.
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2937 (AD--728839) ACTIVE ENERGY STORAGE MATERIALS FOR INTEGRATED CELL STACKS. FINAL REPORT, 1 JUL 1970-30 JUN 1971. Fishwick, J.H.; Yeh, W.C.T. (Foote Mineral Co., Exton, Pa. (USA)). Aug 1971. Contract DAAB07-70-C-0173. 48p. (ECOM--0173-F). NTIS.
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2939 (AD--730867) INTERCELL PLANAR HEAT

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2941 (AD--732349) STUDY OF THE DISCHARGE OF POROUS AG/$AG_2O$ ELECTRODES IN CONCENTRATED POTASSIUM HYDROXIDE ELECTROLYTE. DOCTORAL THESIS. Gagnon, E.G.; Austin, L.G. (Pennsylvania State Univ., University Park (USA). Dept. of Materials Science). Sep 1971. Contract DAAG39-67-C-0065. 182p. (HDL--065-4). NTIS.
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2945 (AD--736460) BATTERY ZINC ELECTRODE KINETICS INVESTIGATION. ANNUAL REPORT NO. 2, 15 DEC 1970--15 DEC 1971. Dirkse, T.P. (Calvin Coll., Grand Rapids, Mich. (USA). Dept. of Chemistry). Dec 1971. Contract F33615-70-C-1022. 35p. (AFAPL-TR--71-96). NTIS.
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2946 (AD--740552) DEVELOPMENT OF A PLANAR HEAT PIPE FOR COOLING LARGE CAPACITY BATTERIES. Mahefkey, E.T., Jr. (Air Force Aero-Propulsion Lab., Wright-Patterson AFB, Ohio (USA)). Dec 1971. 94p. (AFAPL-TR--71-39). NTIS.
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2968 (AD--762181) DC TO DC CONVERSION FOR IMPROVED POWER SOURCES. RESEARCH AND DEVELOPMENT TECHNICAL REPORT. Dudley, W.L. (Army Electronics Command, Fort Monmouth, N.J. (USA)). Apr 1973. 32p. (ECOM--4108). NTIS.
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3056 (AD--866147) NICKEL HYDROXIDE ELECTRODE RESEARCH. INTERIM TECHNICAL REPORT NO. 1, 1 JANUARY 1969--2 FEBRUARY 1970. Christopher, H.A.; Weininger, J.L.; Ruzzo, J.G.; Thornton, R.F.; Moran, P.J. (General Electric Co., Schenectady, N.Y. (USA). Research and Development Center). Feb 1970. Contract F33615-69-C-1312. 2p. (S--70-1025).
Effects of cation additions to active material. NICKEL HYDROXIDES;SPACE VEHICLES; AIRCRAFT;ADDITIVES;PERFORMANCE;SINTERED MATERIALS;PEROXIDES;COBALT;ZINC;CORROSION; ELECTRODES;ELECTRIC BATTERIES;IRON-NICKEL BATTERIES;NICKEL-CADMIUM BATTERIES;NICKEL-ZINC BATTERIES;CATHODES

3057 (AD--866639) EVALUATION OF METAL--AIR ELECTROCHEMICAL ENERGY STORAGE SYSTEM FOR VEHICLE PROPULSION. SEMIANNUAL REPORT, 27 MAY--27 NOVEMBER 1969. Pouli, D.; Seibold, J.G. (Allis-Chalmers Mfg. Co., Greendale, Wis. (USA). Advanced Electrochemical Products Div.). Jan 1970. Contract DAAK02-69-C-0562. 27p. NTIS.
ZINC-AIR BATTERIES;ANODES;ZINC;DEPOSITION; ELECTRIC-POWERED VEHICLES;HYDROXIDES; PERFORMANCE

3058 (AD--868159) APPLICATION OF HEAT PIPES TO MILITARY VEHICLE WINTERIZATION METHODS. Scheps, P.B. (Army Tank-Automotive Command, Warren, Mich. (USA)). Feb 1970. 37p. (TACOM-TR--10863). NTIS.
ELECTRIC BATTERIES;HEATING;HEAT PIPES; VEHICLES;TESTING;HEAT EXCHANGERS;HEAT SINKS; HEATERS

3059 (AD--877313) MANUFACTURING METHODS AND TECHNOLOGY MEASURE FOR STANDARD BATTERY CASES. QUARTERLY REPORT NO. 3, 1 MAY--31 JULY 1970. Gordon, D.V.; Carr, E.S. (Eagle-Picher Industries, Inc., Joplin, Mo. (USA). Couples Dept.). Nov 1970. Contract DAAB05-70-C-3110. 23p. NTIS.
FABRICATION;CONTAINERS;STANDARDS;ELECTRIC BATTERIES;METAL-GAS BATTERIES;AIR;QUALITY CONTROL;PLASTICS;EPOXIDES;FUEL CELLS;GLASS; TEXTILES

3060 (AD--878215) DEVELOPMENT OF SINTERED ZINC BATTERY ELECTRODES. PROGRESS REPORT. Weller, R.D. (Naval Ordnance Lab., White Oak, Md. (USA)). Nov 1970. 48p. (NOLTR--70-121).
0.075 to 225 ma/cm². SINTERED MATERIALS; FABRICATION;PERFORMANCE TESTING;EFFICIENCY; ELECTRODES;ZINC;POROSITY;ANODES;SILVER-ZINC BATTERIES;ZINC-AIR BATTERIES;MERCURY;METAL-METAL BATTERIES;ELECTRIC BATTERIES

3061 (AD--878841) PRODUCTION OF DRY PROCESS DIVALENT SILVER OXIDE ELECTRODES BY CONTINUOUS ROLLING. QUARTERLY REPORT NO. 9, DECEMBER 1969--FEBRUARY 1970. Enters, R. (RAI Research Corp., Hauppauge, N.Y. (USA)). Feb 1970. Contract DAAB05-68-C-1801. 32p. NTIS.
SILVER-ZINC BATTERIES;SILVER-CADMIUM BATTERIES;CATHODES;SILVER OXIDES;ROLLING

3062 (AD--879606) INVESTIGATION OF MAINTENANCE-FREE, HIGH-RATE, NICKEL-CADMIUM BATTERY POWER SYSTEM FOR AIRCRAFT APPLICATION. FINAL TECHNICAL REPORT. Kantner, E.; Lennon, H. (Gulton Industries, Inc., Metuchen, N.J. (USA)). Dec 1970. Contract AF33(615)-5357. 292p.
AIRCRAFT;NICKEL-CADMIUM BATTERIES;BATTERY CHARGERS;DESIGN;HYDROXIDES;RELIABILITY;LOW TEMPERATURE;EFFICIENCY

3063 (AD--880896) MANUFACTURING METHODS AND TECHNOLOGY MEASURE FOR STANDARD BATTERY CASES. QUARTERLY REPORT NO. 4, 1 AUGUST--31 OCTOBER 1970. Gordon, D.V.; Carr, E.S. (Eagle-Picher Industries, Inc., Joplin, Mo. (USA). Couples Dept.). Feb 1971. Contract DAAB05-70-C-3110. 29p. NTIS.
Metal-air batteries. METAL-GAS BATTERIES;AIR; CONTAINERS;STANDARDS;FABRICATION;FUEL CELLS; PLASTICS;EPOXIDES;STYRENE;MOLDING

3064 (AD--881187) MANUFACTURING METHODS FOR HIGH PERFORMANCE POLYETHYLENE BATTERY SEPARATORS. INTERIM ENGINEERING PROGRESS REPORT NO. 4, 1 SEPTEMBER 1970--31 JANUARY 1971. Spacek, E.; Lee, J.; D'Agostino, V. (RAI Research Corp., Hauppauge, N.Y. (USA)). Feb 1971. Contract F33615-70-C-1193. 48p. (RAI--425). NTIS.
BATTERY SEPARATORS;POLYETHYLENES;FABRICATION; GRAFT POLYMERS;FILMS;HYDROXIDES;QUALITY CONTROL; EQUIPMENT;DESIGN

3065 (AD--882182) BATTERY CHARGER PP-6309( )/U. FINAL REPORT, 1 JUL 1969--30 JUL 1970. Froeschle, T.A.; Hill, H.W. Jr. (Bose Corp., Framingham, Mass. (USA)). Jan 1971. Contract DAAB07-69-C-0405. 90p. NTIS $5.00.
The performance data and design configuration of the PP-6309 ( )/U Battery Charger is delineated. Performance of the unit is summarized and analyzed. Terminal performance and selected aspects of internal performance are considered. The internal system configuration of the Battery Charger is presented in block form. Functions of individual system blocks are discussed to define their behavior. Circuit components used to implement the system blocks are identified. The PP-6309 ( )/U Battery Charger is designed to charge 24 Vdc--28 Vdc batteries at adjustable charging rates from 5 Adc--15 Adc. The unit operates from 28 Vdc power sources having the characteristics of MIL-STD-704A. The Battery Charger is housed in a finned rectangular enclosure; the total weight is 26 pounds. (auth)

3066 (AD--882183) BATTERY CHARGER PP-4126( )/U. FINAL REPORT, 1 JUL 1969--30 JUL 1970. Froeschle, T.A.; Hill, H.W. Jr. (Bose Corp., Framingham, Mass. (USA)). Feb 1971. Contract DAAB07-69-C-0405. 174p. NTIS $6.75.
The performance data and design configuration of the PP-4126 ( )/U Battery Charger is delineated. Performance of the unit

is summarized. Terminal performance and selected aspects of internal performance are considered. The internal system configuration of the battery charger is presented in block form. Functions of individual system blocks are discussed to define their behavior. Circuit components used to implement the system blocks are identified. The PP-4126 ( )/U Battery Charger is designed to charge 6, 12, and 24 Vdc batteries at selectable charging rates from 0.1 Adc to 15 Adc. The battery charger operates from both dc and ac power sources. (auth)

3067 (AD--882890) ORGANIC ELECTROLYTE PERMSELECTIVE MEMBRANES. REPORT NO. 4 (FINAL), 1 APRIL 1968--15 SEPTEMBER 1970. Dampier, F.W.; Spiegler, K.S. (Army Electronics Command, Fort Monmouth, N.J. (USA)). Mar 1971. Contract DAAB07-67-C-0590. 78p.

Li/electrolyte in propylene carbonate/Cu halide. METAL-NONMETAL BATTERIES;BATTERY SEPARATORS;CARBONIC ACID ESTERS;MEMBRANES; LITHIUM;COPPER HALIDES;AQUEOUS SOLUTIONS; DIFFUSION;MASS TRANSFER;ELECTRIC CONDUCTIVITY; ION EXCHANGE MATERIALS;CHEMICAL COMPOSITION; MATERIALS

3068 (AD--882890) ORGANIC ELECTROLYTE PERMSELECTIVE MEMBRANES. REPORT NO. 4 (FINAL), 1 APR 68--15 SEP 70. Dampier, F.W.; Spiegler, K.S. (California Univ., Berkeley (USA). Sea Water Conversion Lab.). Mar 1971. Contract DAAB07-67-C-0590. 78p. NTIS, PC A05/MF A01.

See also AD--859386.

Experiments were performed to assess the value of various commercial and specially-prepared membranes as separators in batteries containing electrolytes dissolved in propylene carbonate (PC). Specifically, these membranes should prevent self-discharge of lithium--copper halide cells. Since literature data suggest that self-discharge is caused by transport of anionic copper complexes to the lithium electrode, the separators selected were primarily cation-exchange membranes, which are known to exclude anions in aqueous solutions. Selective permeability for anions was tested by a variety of electrolyte diffusion, interdiffusion and transport number measurements. It was established that most commercial cation-exchange membranes have high resistances in PC, but three membranes with resistances less than 250 ohms sq cm in 0.50 M LiClO4/PC at 25 C were found, viz. C-322 (American Machine and Foundry Co., Stamford, Conn. - 117 ohm sq cm), UM-05 (Amicon Corp., Lexington, Mass. - 230 ohm sq cm) and 7930 Porous Glass (Corning Glass Works, Corning, N.Y. - 75 ohms sq cm). In order to combine the advantages of cation selectivity with low resistance, laminated membranes consisting of thin layers of phenolsulfonic acid--formaldehyde cation-exchange membranes on porous inert supports were prepared and tested. The data indicate that anion-barrier membranes of low resistance can be prepared by further developing this method. (auth)

3069 (AD--883905) NICKEL HYDROXIDE BATTERY ELECTRODE DEVELOPMENT. ANNUAL INTERIM REPORT NO. 2, 1 JANUARY--31 DECEMBER 1970. Kroger, H.H. (General Electric Co., Gainesville, Fla. (USA). Battery Product Section). Jan 1971. Contract F33615-69-C-1312. 183p. NTIS.

20 Ah. NICKEL-CADMIUM BATTERIES;NICKEL HYDROXIDES;CATHODES;POWDER METALLURGY;ELECTRIC POTENTIAL;ELECTRODEPOSITION;COBALT;ADDITIVES; PERFORMANCE

3070 (AD--884722) MANUFACTURING METHODS FOR HIGH-PERFORMANCE POLYETHYLENE BATTERY SEPARATORS. INTERIM ENGINEERING REPORT NO. 5, 1 FEBRUARY--31 MAY 1971. Lee, J.; D'Agostino, V.F. (RAI Research Corp., Hauppauge, N.Y. (USA)). Jun 1971. Contract F33615-70-C-1193. 45p. (RAI--426). NTIS.

BATTERY SEPARATORS;GRAFT POLYMERS;CHEMICAL RADIATION EFFECTS;POLYMERIZATION;FABRICATION; POLYETHYLENES;FILMS;DESIGN;QUALITY CONTROL; HYDROXIDES;ELECTRIC BATTERIES

3071 (AD--887653) CARBON-BASED OXYGEN ELECTRODES FOR METAL--AIR BATTERIES. I. EXPERIMENTAL ELECTRODES. Armstrong, W.A.; Levesque, G.C. (Defence Research Establishment, Ottawa, Ontario (Canada)). Jun 1971. 16p. (DREO--636).

ACTIVATED CARBON;ZINC-AIR BATTERIES;METAL-GAS BATTERIES;AIR;MAGNESIUM;MANGANESE OXIDES; CATHODES;OXYGEN;CATALYSTS;REDUCTION;FABRICATION; BINDERS;HOT PRESSING;AQUEOUS SOLUTIONS; HYDROXIDES

3072 (AD--891776) STORAGE OF CHARGED NICKEL HYDROXIDE ELECTRODES. Lepage, W.A.; Humphreys, W.G.; Haines, R.L. (Defence Research Establishment, Ottawa, Ontario (Canada)). Dec 1971. 15p. (DREO-TN--71-37).

NICKEL-ZINC BATTERIES;CATHODES;NICKEL HYDROXIDES;STORAGE;ELECTROLYTES;POTASSIUM HYDROXIDES;WATER;AIR;HIGH VACUUM;PERSULFATES; POTASSIUM COMPOUNDS;ELECTRIC CHARGES;CRYSTAL LATTICES

3073 (AD--894816L) MANUFACTURING METHODS AND TECHNOLOGY MEASURE FOR STANDARD BATTERY CASES. QUARTERLY REPORT NO. 9, 1 NOV 1971-31 JAN 1972. Gordon, D.V. (Eagle-Picher Industries, Inc., Joplin, Mo. (USA). Couples Dept.). Apr 1972. Contract DAAB05-70-C-3110. 14p. DDC.

ELECTRIC BATTERIES;CONTAINERS;FABRICATION; PRODUCTION;PILOT PLANTS;FUEL CELLS;QUALITY CONTROL;MACHINE TOOLS;DESIGN;OPTIMIZATION; RELIABILITY;ECONOMICS

3074 (AD--896566L) FAST CHARGING TECHNIQUES FOR MASS CHARGING OF NICKEL--CADMIUM BATTERIES. TECHNICAL REPORT. Haymes, A.J. (Dugway Proving Ground, Utah (USA)). Jun 1968. 42p. (DPG-DD--68-21). DDC.

NICKEL-CADMIUM BATTERIES;BATTERY CHARGERS; BATTERY CHARGING;RELIABILITY;POWER SUPPLIES; ELECTRIC POTENTIAL;ELECTRIC CURRENTS; MAINTENANCE;LEAKS;VENTILATION;TRANSPORT

3075 (AD--900561L) TOW. MONTHLY TECHNICAL REPORT NO. 118, 1-31 MAY 1972. (Hughes Aircraft Co., Culver City, Calif. (USA)). Jun 1972. Contract DAAH01-72-C-0052. 17p. DDC.

Guided missile battery charger. MISSILES; ELECTRIC BATTERIES;BATTERY CHARGERS;DESIGN; TESTING;COST;PRODUCTION;MAINTENANCE;VEHICLES; POWER SUPPLIES

3076 (AD--900702L) EVALUATION OF 'DARAMIC' POLYETHYLENE SEPARATORS USING GOULD TYPE TPX-61-E, GUPPY I, LEAD--ANTIMONY SUBMARINE MAIN STORAGE BATTERY CELLS ON A SERVICE LIFE TEST. TECHNICAL REPORT. Newton, D.O.; Miller, W.H. (Mare Island Naval Shipyard, Vallejo, Calif. (USA)). May 1972. 48p. DDC.

BATTERY SEPARATORS;POLYETHYLENES;LEAD; ANTIMONY;LIFETIME;PERFORMANCE TESTING;

SUBMARINES;ANODES;CATHODES;ELECTRIC BATTERIES

3077 (AD--901747L) EVALUATION TESTS OF ALKALINE VENT CAPS. Senderak, K.L. (Naval Ammunition Depot, Crane, Ind. (USA)). Jun 1972. 11p. (QEEL/C--72-211). DDC.
AIRCRAFT;ELECTRIC BATTERIES;VENTS;CLOSURES; TESTING;SHEETS;RUBBERS;WEIGHT;IMPACT SHOCK; MECHANICAL VIBRATIONS

3078 (AD--901918L) POROUS OXYGEN OR AIR ELECTRODE FOR USE IN ZINC--AIR BATTERIES. (Army Foreign Science and Technology Center, Charlottesville, VA). Apr 1972. 9p. (FSTC-HT--23-684-72). DDC.
Translation of French Republic patent No. 1,595,438, by E.J. Armstrong.
ZINC-AIR BATTERIES;CATHODES;ELECTROLYTES; OXYGEN;ELECTROCHEMISTRY

3079 (AD--902276L) TOW WEAPON SYSTEM CHECK TEST PROGRAM FOR TOW INITIAL PRODUCTION BATTERY CHARGERS. TEST EVALUATION REPORT. Heatherington, B.W. (Army Missile Command, Redstone Arsenal, Ala. (USA)). Apr 1972. 26p. (RT-TR--72-10). DDC.
BATTERY CHARGERS;MISSILES;TESTING; PERFORMANCE;INSPECTION;SEALS;EFFICIENCY; MECHANICAL VIBRATIONS;LOW TEMPERATURE;LEAKS; STRAIN HARDENING;FRACTURES;WIRES;QUALITY CONTROL;MAINTENANCE;EQUIPMENT

3080 (AD--902658L) SUSCEPTIBILITY TO OXIDATION OF COAL AND GRAPHITE ELECTRODES. Mizera, J.; Gmyrek, J. (Army Foreign Science and Technology Center, Charlottesville, VA). Apr 1972. 14p. (FSTC-HT--23-1099-72). DDC.
Translation of Koks, Smola, Gaz (Poland), 14: No. 1, 4-8(1969).
ELECTRODES;OXIDATION;CARBON;GRAPHITE; INHIBITION;PHOSPHORIC ACID;ANTIOXIDANTS;HIGH TEMPERATURE;IMPREGNATION;ELECTRIC BATTERIES

3081 (AD--903276L) EXPLORATORY DEVELOPMENT OF NON-AQUEOUS HIGH RATE BATTERIES. PHASE I. QUARTERLY PROGRESS REPORT NO. 2, 15 APR-15 JUN 1972. Wong, K.M. (Electrochimica Corp., Mountain View, Calif. (USA). Research and Development Lab.). Jul 1972. Contract N00017-72-C-1317. 24p. (ELCA--5.185). DDC.
Li/$CuCl_2$. METAL-NONMETAL BATTERIES; ELECTROLYTES;LITHIUM;COPPER CHLORIDES;BATTERY SEPARATORS;NICKEL;SILVER;ELECTROCHEMISTRY; LIFETIME;POLYPROPYLENE;DESIGN

3082 (AD--903317L) STABILITY OF LEAD DIOXIDE ELECTRODE STOCK DURING STORAGE AT 160°F. Comyn, R.H. (Harry Diamond Labs., Washington, D.C. (USA)). Jul 1972. 43p. (HDL-TR--1605). DDC.
LEAD-ACID BATTERIES;CATHODES;LEAD OXIDES; STABILITY;STORAGE;MEDIUM TEMPERATURE;LOW TEMPERATURE;PERFORMANCE;POLYETHYLENES;NITRATES; DECOMPOSITION;ORGANIC POLYMERS;BORIC ACID; HUMIDITY;FLUORINE COMPOUNDS

3083 (AD--904851L) ELECTROCHEMICAL CHARACTERISTICS OF POROUS SILVER/SILVER CHLORIDE ELECTRODES. FINAL REPORT, 23 JUN 1971-23 SEP 1972. Katan, T. (Lockheed Missiles and Space Co., Palo Alto, Calif. (USA). Research Labs.). Sep 1972. 67p. (LMSC--D309658). DDC.
SILVER CHLORIDES;ELECTRODES;POTASSIUM CHLORIDES;ANODES;CATHODES;OXIDATION;REDUCTION; SILVER ALLOYS;ELECTROCHEMISTRY;ELECTRIC BATTERIES;PERFORMANCE;CHEMICAL REACTIONS;FILMS; SPHERES;DIRECT CURRENT;BATTERY CHARGERS; EFFICIENCY;ELECTRODEPOSITION;CRYSTAL LATTICES; DIFFUSION;IONS

3084 (AD--904964L) MANUFACTURING METHODS AND TECHNOLOGY MEASURE FOR STANDARD BATTERY CASES. FINAL REPORT, 14 OCT 1969-30 SEP 1972. Gordon, D.V. (Eagle-Picher Industries, Inc., Joplin, Mo. (USA). Couples Dept.). Sep 1972. Contract DAAB05-70-C-3110. 123p. DDC.
FABRICATION;ELECTRIC BATTERIES;FUEL CELLS; CONTAINERS;QUALITY CONTROL;ORGANIC POLYMERS; GLASS;EPOXIDES;POLYESTERS

3085 (AD--905408) NICKEL/CADMIUM AIRCRAFT BATTERIES: FLOAT CHARGE TEST EQUIPMENT. TECHNICAL NOTE. Lepage, W.A.; Feldman, K.; Auprey, F.; Willis, P. (Defence Research Establishment, Ottawa, Ontario (Canada)). Oct 1972. 18p. (In French). (DREO-TN--72-22). NTIS.
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3086 (AD--905612L) INVESTIGATION OF UNREGULATED CONVERTERS AS BATTERY CHARGES IN A-6 AIRCRAFT. REPORT NO. 1 (FINAL), NOV 1971-JUN 1972. (Naval Air Test Center, Patuxent River, Md. (USA)). Dec 1972. 5p. (NATC-WST--149R-72). DDC.
NICKEL-CADMIUM BATTERIES;BATTERY CHARGERS; AIRCRAFT;MAINTENANCE;RECTIFIERS;TRANSFORMERS; ELECTRIC POTENTIAL;REDUCTION;TESTING

3087 (AD--906063) OXYGEN ELECTRODE BASED ON SINTERED NICKEL PLAQUE IMPREGNATED WITH MANGANESE DIOXIDE. Armstrong, W.A. (Defence Research Establishment, Ottawa, Ontario (Canada)). Mar 1972. 22p. (DREO-R--657). NTIS.
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3088 (AD--907721L) OXYGEN REDUCTION IN ALKALINE SOLUTIONS AT POROUS NICKEL ELECTRODES WHICH HAVE BEEN ACTIVATED WITH SEVERAL PRECIOUS METALS. Drazic, D.M.; Vujcic, V.; Rakin, P.M.; Vljnovic, M.V.; Sepa, D.B. (Army Foreign Science and Technology Center, Charlottesville, VA). Dec 1972. 8p. (FSTC-HT--23-1301-72). DDC.
Translation of Metalloberflaeche, 24: No. 10, 380-2(1970).
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3089 (AD--908040L) AMOUNT AND FORMS OF ADSORBED HYDROGEN ON A PLATINUM ELECTRODE. Nakamura, M. (Army Foreign Science and Technology Center, Charlottesville, VA). Dec 1972. 13p. (FSTC-HT--23-1506-72). DDC.
Translation of Nippon Kagaku Zasshi (Japan), 92: No. 11, 938-41(Nov 1971).
LEAD-ACID BATTERIES;ELECTRODES;ADSORPTION; HYDROGEN;PLATINUM;ELECTROCHEMISTRY;TESTING; SULFURIC ACID;ELECTRIC CONDUCTIVITY

3090 (AD--908253L) CHLORINE STORAGE AND DISTRIBUTION SYSTEM FOR THE LITHIUM--CHLORINE BATTERY. ANNUAL PROGRESS REPORT. Min, S.L.

(Naval Ordnance Lab., White Oak, Md. (USA)). Sep 1972. 27p. (NOLTR--72-244). DDC.
METAL-GAS BATTERIES;LITHIUM;CHLORINE;STORAGE; HEATING;VAPOR PRESSURE;PRESSURE VESSELS;SHELLS; STRESSES;TENSILE PROPERTIES;GAS FLOW

3091 (AD--908400L) NEW RESULTS FROM THE TECHNOLOGICAL DEVELOPMENT OF AN INDUSTRIAL CONCERN. Brunner, A. (Army Foreign Science and Technology Center, Charlottesville, VA). Sep 1972. 23p. (FSTC-HT--23-2241-72). DDC.
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Catalytic activity of tungsten carbide electrode. GERMAN FEDERAL REPUBLIC;RESEARCH PROGRAMS;LECTURES;FUEL CELLS;ELECTRIC BATTERIES; ELECTRIC CONDUCTIVITY;ELECTRODES;COMPUTERS;DATA PROCESSING;ELECTROLUMINESCENCE;CATALYSTS; TUNGSTEN CARBIDES;ELECTRONIC CIRCUITS;CONTROL SYSTEMS;CHARGE CARRIERS;RAILWAYS

3092 (AD--909331L) EFFECTS OF SILVER COMPLEX ION ON THE ELECTRODE REACTION OF SILVER--SILVER OXIDE SYSTEMS IN ALKALINE SOLUTION. Furukawa, N. (Army Foreign Science and Technology Center, Charlottesville, VA). Jan 1973. 12p. (FSTC-HT--23-1764-72). DDC.
Translation of Denki Kagaku (Japan), 39: No. 11, 873-7(Nov 1971).
SILVER-ZINC BATTERIES;ELECTROCHEMISTRY; ELECTRODES;SILVER COMPLEXES;SILVER IONS;ANODES; CATHODES;OXIDATION;REDUCTION;ELECTRIC CURRENTS; POTASSIUM HYDROXIDES;SILVER;SILVER OXIDES

3093 (AD--909458L) SERVICE EVALUATION OF AIRCRAFT BATTERY CHARGER, ELECTRO DEVELOPMENT CORPORATION MODEL EDC 2-301-3. REPORT NO. 2 (FINAL), APR 1970-AUG 1972. (Naval Air Test Center, Patuxent River, Md. (USA)). Apr 1973. 4p. (NATC-WST--63R-73). DDC.
BATTERY CHARGERS;NICKEL-CADMIUM BATTERIES; AIRCRAFT;ELECTRIC CURRENTS;ELECTRIC POTENTIAL; WEIGHT;FAILURES;PERFORMANCE TESTING;MEDIUM TEMPERATURE

3094 (AD--909496L) ELECTRODES FOR ALKALINE ZINC STORAGE BATTERIES. Hladik, O. (Army Foreign Science and Technology Center, Charlottesville, VA). Dec 1972. 5p. (FSTC-HT--23-1179-72). DDC.
Translation of patent 73,554 (E. Germany), 1970.
G.D.R. patent. ELECTRODES;ZINC;LIFETIME; NICKEL-ZINC BATTERIES;SILVER-ZINC BATTERIES; ZINC-MANGANESE BATTERIES;ZINC-AIR BATTERIES; ZINC-CHLORINE BATTERIES;ELECTRIC BATTERIES

3095 (AD--909885L) ELECTRODE FOR GALVANIC ELEMENTS, ESPECIALLY FOR ALKALINE STORAGE BATTERIES. Wiesenhuetter, J.; Brackmann, E.; Bauer, R. (Army Foreign Science and Technology Center, Charlottesville, VA). Mar 1973. 5p. (FSTC-HT--23-1178-72). DDC.
Translation of DDR patent 74,867 (E. Germany).
ELECTRODES;GASES;ADSORPTION;METALS;COATINGS; CHEMICAL REACTIONS;ELECTRODEPOSITION;REDUCTION; VAPOR PLATING;ELECTROLYTES;POWDER METALLURGY; MECHANICAL PROPERTIES;SINTERING;ORGANIC POLYMERS;SILVER;NICKEL;PVA;ELECTRIC BATTERIES; HYDROXIDES

3096 (AD--910738L) CURRENT DISCHARGE FRAME FOR ELECTRODES OF LEAD STORAGE BATTERIES. Faber, P. (Army Foreign Science and Technology Center, Charlottesville, VA). Dec 1972. 7p. (FSTC-HT--23-1181-72). DDC.
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Alkaline battery; patent. ELECTRODES;LEAD; ELECTRIC BATTERIES;TITANIUM;SILICON;WEIGHT; PLATINUM;THICKNESS;OXIDES

3097 (AD--911460L) SECONDARY ZINC--OXYGEN BATTERIES. SEMI-ANNUAL REPORT. Klein, M. (Energy Research Corp., Bethel, Conn. (USA)). May 1973. Contract DAAB07-72-C-0272. 48p. (ECOM--0272-S-72). DDC.
Study of Ag--Ni catalyzed bifunctional and Ag-amalgam-catalyzed monofunctional O electrodes for zinc--oxygen batteries. ZINC-AIR BATTERIES;ELECTRODES;BATTERY SEPARATORS;GOLD; NICKEL;DIFFUSION;ELECTROLYTES;LIFETIME; POTASSIUM COMPOUNDS;TITANATES;HYDROXIDES

3098 (AD--911508) RAPID CHARGER FOR MAINTENANCE-FREE BATTERIES. SEMI-ANNUAL REPORT, 1 MAY-31 DEC 1971. Hermann, J.A. (Gould, Inc., Mendota Heights, Minn. (USA)). Mar 1973. Contract DAAB07-71-C-0209. 72p. (ECOM--0209-1-71). NTIS.
BATTERY CHARGERS;NICKEL-CADMIUM BATTERIES; SILVER-ZINC BATTERIES;DESIGN;FABRICATION; OPERATION;AUTOMATION;INTEGRATED CIRCUITS;LOGIC CIRCUITS;MAINTENANCE;DIAGRAMS

3099 (AD--911508) RAPID CHARGER FOR MAINTENANCE-FREE BATTERIES. SEMI-ANNUAL REPORT 1 MAY--31 DEC 71. Hermann, J.A. (Gould, Inc., Mendota Heights, Minn. (USA)). Mar 1973. Contract DAAB07-71-C-0209. 72p. NTIS $4.50.
The purpose of this program was to evaluate various charging approaches for rapid charging of sealed nickel--cadmium, vented nickel--cadmium, and silver zinc--oxide batteries. A programable charger was to be designed, manufactured and used as a tool during the evaluation of the various charging approaches. To accomplish the objectives, a paper design and breadboard of the circuitry for the programable charger was initiated at the beginning of the contract. Throughout the first nine months of the program, the charger was designed, breadboard portions were evaluated, and final hardware was built. Upon the completion of initial hardware, the system was checked out and problem areas was corrected. The charger was designed to have five basic operating modes with each having necessary controls for varying charge current, discharge current, charge frequency, and mode selection. As of the time period covered by this report, no testing of charge approaches has started; therefore, the only results which can be stated are that a working programable charger was designed, fabricated, and tested. (auth)

3100 (AD--912458) FAILURE ANALYSIS OF POROUS ELECTRODES. FINAL REPORT. Bennion, D.N.; Gu, H.; Hebbar, R.K. (California Univ., Los Angeles (USA). School of Engineering and Applied Science). May 1973. Contract N00019-72-C-0256. 28p. (UCLA-ENG--7347). NTIS.
Ag/AgCl electrodes; output of Li/$LiClO_4$, DMSU/C, LiF cell. ELECTRODES;FAILURES;SILVER; SILVER CHLORIDES;ELECTROCHEMISTRY;ELECTRIC BATTERIES;CHEMICAL REACTION KINETICS;LITHIUM; LITHIUM COMPOUNDS;CHLORATES;CARBON;LITHIUM FLUORIDES;DMSO;METAL-NONMETAL BATTERIES; PERFORMANCE

3101 (AD--912458) FAILURE ANALYSIS OF POROUS ELECTRODES. FINAL REPORT. Bennion, D.N.; Gu, H.; Hebbar, R.K. (California Univ., Los Angeles (USA). School of Engineering and

Applied Science). May 1973. Contract N00019-72-C-0256. 28p. (UCLA-ENG--7347). NTIS $4.00.

A single pore Ag/AgCl electrode was constructed for the study of elementary processes that occur in porous electrodes. X-ray element scan was applied to determine the average local transfer current densities inside the pore. The morphology of AgCl on the surface of silver was studied by using a scanning electron microscope. It was found that the size of AgCl particles depended on the average local current densities and the local electrolyte concentrations. Higher current densities gave smaller AgCl mounds, in general. The formation of AgCl was also observed to form mainly from electrolyte diffusion paths as opposed to solid phase diffusion. A porous structure of silver was observed after cycling. The use of intercalation compounds of graphite as reactants in nonaqueous secondary batteries has been investigated. Experiments were carried out on a cell of the type Li/$LiClO_4$, DMSU/C,LiF. Two discharge plateaus were observed, one occurring above 4.0 V, and another, more predominant one, between 2.8 and 2.5 V. The lower discharge plateau is characteristic of the discharge plateau of a primary battery using fluorographite as the reactant. The higher discharge plateau is probably do to the formation of the intercalation compound $CnClO_4$ (n>1). The lower discharge plateau is comparable to the behavior of the cells described by Watanabe, et al., (1970) and Brauer (1970) using flourographite as the reactant. (auth)

3102 (AD--913488L) EVALUATION OF LEAD--ACID STORAGE BATTERY VENT PLUGS TO PROPOSED REVISION OF MIL-V-8800. Senderak, K.L. (Naval Ammunition Depot, Crane, Ind. (USA)). Aug 1973. 36p. (QEEL/C--73-240). DDC.
LEAD-ACID BATTERIES;PERFORMANCE TESTING; VENTS;CLOSURES;PERFORMANCE;LEAKS

3103 (AD--913957L) RAPID CHARGER FOR MAINTENANCE-FREE BATTERIES. FINAL REPORT. Herrmann, J.A. (Gould, Inc., Mendota Heights, Minn. (USA)). Oct 1973. Contract DAAB07-71-C-0209. 116p. (ECOM--0209-F-71). DDC.
BATTERY CHARGERS;NICKEL-CADMIUM BATTERIES; SEALS;SILVER-ZINC BATTERIES;DESIGN;BATTERY CHARGING;TESTING;MAINTENANCE;ELECTRIC POTENTIAL

3104 (AD--914248) ELECTROCHEMICAL ENGINEERING OF BATTERY SYSTEMS. FINAL REPORT, 10 NOV 1971--9 NOV 1972. Manis, L. (Pennsylvania Univ., Philadelphia (USA)). Oct 1973. Contract N00019-72-C-0166. 91p. NTIS $7.75; $1.45 (mf).
Use of scattered light to determine battery operation without disturbance. NICKEL-CADMIUM BATTERIES;ELECTRODES;LIGHT SCATTERING; REFLECTION;CHEMICAL REACTIONS;PASSIVATION; OPTICAL PROPERTIES

3105 (AD--914248) ELECTROCHEMICAL ENGINEERING OF BATTERY SYSTEMS. FINAL REPORT, 10 NOV 1971--9 NOV 1972. Manis, L. (Pennsylvania Univ., Philadelphia (USA). Dept. of Chemical and Biochemical Engineering). Oct 1973. Contract N00019-72-C-0166. 91p. NTIS $5.00.
Changes in diffusely reflected light scattered from a battery electrode (Cd negative) have been shown to be well correlated with the electrochemical benavior. Change in the diffusely reflected light from the current collector side of a cadmium negative (anode for discharge) precedes the onset of rapid passivation type of polarization determined at the front (solution) side of the porous electrode. The chemical change of Cd to $Cd(OH)_2$ during discharge is considered to cause the variation of optical parameters for light scattering and absorption and thus the change in diffuse reflectance. The monitoring by optical changes corresponding to the material changes of the current collector region of the anode permits determination of the essential features of the profile without disturbing the battery operation. Thus, cycling effects on the current redistribution can be analyzed and effective battery performance, evaluated. (auth)

3106 (AD--914883L) THYRISTOR BATTERY CHARGER FOR SHIPS. Vrtikapa, G. (Army Foreign Science and Technology Center, Charlottesvile, VA). Jul 1973. 12p. (FSTC-HT--23-2105-72). DDC.
Translation of Brodogradnja No. 21 (USSR), No. 7, 448-92(1970).
ELECTRIC BATTERIES;BATTERY CHARGERS;SHIPS; THYRISTORS;RECTIFIERS;VOLTAGE REGULATORS; ELECTRIC POTENTIAL;AUTOMATION;LEAD-ACID BATTERIES;ELECTRONIC CIRCUITS;CONTROL SYSTEMS

3107 (AD--917948L) EVALUATION OF IMPROVED SEPARATOR MATERIAL IN LARGE SILVER ZINC CELLS. FINAL REPORT. Work, G.W.; Solis, M. (Yardney Electric Corp., Pawcatuck, Conn. (USA)). Jan 1974. Contract N00024-73-C-5042. 92p. DDC.
See also AD--917239L.
SILVER-ZINC BATTERIES;BATTERY SEPARATORS; SUBMARINES;SPECIFICATIONS;POWER SUPPLIES; PERFORMANCE;FABRICATION

3108 (AD--918225L) QUALIFICATION TESTS OF FOUR TYPE MS3509, STYLE 1, BATTERY RECEPTACLES, MANUFACTURED BY ELCON, DIVISION OF ICORE INTERNATIONAL, INC. (Naval Ammunition Depot, Crane, Ind. (USA)). Apr 1974. 6p. (QEEL/C--74-213). DDC.
CONTAINERS;LEAD-ACID BATTERIES;ELECTRIC BATTERIES;MOLDING;CONNECTORS;MECHANICAL TESTS; THERMAL TESTING;PERFORMANCE;QUALITY ASSURANCE

3109 (AD--919452L) OV-10A AIRCRAFT NI--CD BATTERY AND CHARGING SYSTEM INVESTIGATION. REPORT NO. 1, (FINAL), APR-SEP 1973. (Naval Air Test Center, Patuxent River, Md. (USA)). May 1974. 16p. (NATC-WST--40R-74). DDC.
AIRCRAFT;NICKEL-CADMIUM BATTERIES;BATTERY CHARGERS;POWER SUPPLIES;VOLTAGE REGULATORS; SPECIFICATIONS

3110 (AD--A032298) MICROSTRUCTURAL COMPARISON OF POSITIVE FLOAT AND TRICKLE DISCHARGE OPERATIONS ON THE POSITIVE ELECTRODES OF SUBMARINE STORAGE BATTERIES WITH LEAD--CALCIUM ALLOY GRIDS. MASTER'S THESIS. Coyle, M.T. (Naval Postgraduate School, Monterey, Calif. (USA)). Sep 1976. 176p. NTIS, PC A09/MF/A01.
Lead--calcium alloy grid batteries are utilized as the backup emergency power supply on non-Diesel-electric submarines. Sudden and premature capacity losses have been experienced when these batteries are operated in a float mode while in standby conditions, hence a continuous drain, or trickle discharge, is maintained in lieu of float. This requires periodic battery charges to restore full capacity. The microstructural effects of float and trickle discharge operation on positive plates from small cells, manufactured from full size submarine battery plates, are studied

using a scanning electron microscope. This is complemanted with light microscopy observations and x-ray diffraction analysis. A patterned dendritic network of spiny crystals was discovered to be prevalent in the trickle-discharged plates. This network was seen on the grid surface corrosion layer and on a dense layer found in the internal active material. It is postulated that this network may be related to lead sulfate dissolution upon recharge. (auth)

3111 (AD/A--001572) PERFORMANCE CHARACTERISTICS OF SOLID ELECTROLYTES UNDER STEADY-STATE CONDITIONS. Choudhury, N.S.; Patterson, J.W. (Iowa State Univ. of Science and Technology, Ames (USA). Engineering Research Inst.; Aerospace Research Labs., Wright-Patterson AFB, Ohio (USA)). Feb 1971. Contract F33615-68-C-1034. 34p. (ISU-ERI-AMES--96700). NTIS $3.75.
Yttria-doped thoria, 1600°C. ELECTRIC POTENTIAL;ELECTRIC CURRENTS;SOLIDS;ELECTROLYTES; ELECTRIC BATTERIES;POWER;EFFICIENCY;THORIUM OXIDES;YTTRIUM OXIDES;DOPED MATERIALS;VERY HIGH TEMPERATURE;IONIC CONDUCTIVITY;ELECTRIC CONDUCTIVITY

3112 (AD/A--001610) ELECTROCHEMICAL POWER SOURCES. Aikens, D.A.; Littman, H. (Rensselaer Polytechnic Inst., Troy, N.Y. (USA)). 1975. 87p. NTIS.
ELECTRODES;ELECTROLYTES;SOLUTION HEAT;ALKALI METAL COMPOUNDS;SALTS;NITRILES;CARBONIC ACID DERIVATIVES;SEALS;NICKEL-CADMIUM BATTERIES;HEAT TRANSFER;DIFFUSION;LIQUIDS;GASES;SPATIAL DISTRIBUTION;RESEARCH PROGRAMS;ELECTRIC BATTERIES

3113 (AD/A--001610) ELECTROCHEMICAL POWER SOURCES. FINAL TECHNICAL REPORT, 18 SEPTEMBER 1968--31 JANUARY 1974. Aikens, D.A.; Littman, H. (Rensselaer Polytechnic Inst., Troy, N.Y. (USA)). Sep 1974. 87p. (ECOM--69-0063-F). NTIS $4.75.
ELECTRIC BATTERIES;ELECTRODES;ELECTROLYTES; HEAT TRANSFER;MASS TRANSFER;SOLUTION HEAT; ALKALI METAL COMPOUNDS;MOLTEN SALTS;NITRILES; SOLUTIONS;ORGANIC ACIDS;ESTERS;EVAPORATION; ELECTROCHEMISTRY;NICKEL-CADMIUM BATTERIES; OPERATION;SEALS

3114 (AD/A--002142) HIGH ENERGY DENSITY SINTERED PLATE-TYPE NICKEL--CADMIUM BATTERY CELLS. PART II. ELECTROCHEMICAL IMPREGNATION METHODS TO PRODUCE NICKEL OXIDE ELECTRODES. TECHNICAL REPORT, DECEMBER 1972--DECEMBER 1973. Pickett, D.F.; Puglisi, V.J.; Seiger, H.N.; Oliver, R.L. (Heliotek, Sylmar, Calif. (USA); Air Force Aero-Propulsion Lab., Wright-Patterson AFB, Ohio (USA)). Aug 1974. Contract F33615-73-C-2012. 36p. (AFAPL-TR--74-56-PT-2). NTIS $3.75.
NICKEL-CADMIUM BATTERIES;CATHODES;SINTERED MATERIALS;PLATES;IMPREGNATION;FABRICATION; SATELLITES;NICKEL HYDROXIDES

3115 (AD/A--004071) CHRONOPOTENTIOMETRIC MEASUREMENTS OF ZINC ELECTRODEPOSITION KINETICS FROM CONCENTRATED KOH SOLUTIONS. Mayer, S.W.; Taylor, D. (Aerospace Corp., El Segundo, Calif. (USA)). 17 Dec 1974. Contract F04701-74-C-0075. 19p. NTIS $3.25.
SILVER-ZINC BATTERIES;EFFICIENCY;ZINC; ELECTRODEPOSITION;POTASSIUM HYDROXIDES; SPACECRAFT POWER SUPPLIES;ELECTRODES;LEAD IONS; ADDITIVES;WETTING AGENTS;ANODES; ELECTROCHEMISTRY

3116 (AD/A--005055) DEVELOPMENT OF AN AIRCRAFT BATTERY CONDITIONER/ANALYZER. FINAL REPORT, 19 JUNE 1972--18 DECEMBER 1973. (Chrysler Corp., New Orleans, La. (USA). Space Div.). Dec 1974. Contract DAAJ02-72-C-0108. 44p. NTIS $3.75.
The report documents the development and evaluation of a prototype Programmed Peak Charges (PPC) battery conditioner/analyzer system for nickel-cadmium batteries. It describes testing to determine the advantages of the unit as compared to constant-potential-charge systems. The results show that the PPC system reduces water boiloff, reduces overtemperature conditions, and has fewer battery recycles and cell replacements. Use of the PPC system increases battery life, reduces maintenance, and eliminates hazards. (GRA)

3117 (AD/A--005055/9ST) DEVELOPMENT OF AN AIRCRAFT BATTERY CONDITIONER/ANALYZER. FINAL REPORT, 9 JUNE 1972--18 DECEMBER 1973. (Chrysler Corp., New Orleans, La. (USA). Space Div.). Dec 1974. 44p. (USAAMRDL-TR--74-81). NTIS, PC A03/MF A01.
The report documents the development and evaluation of a prototype Programed Peak Charges (PPC) battery conditioner/analyzer system for nickel--cadmium batteries. It describes testing to determine the advantages of the unit as compared to constant-potential-charge systems. The results show that the PPC system reduces water boiloff, reduces over-temperature conditions, and has fewer battery recycles and cell replacements. Use of the PPC system increases battery life, reduces maintenance, and eliminates hazards.

3118 (AD-A--009116) BATTERY CHARGER PP-7041( ). FINAL REPORT, 30 APR 1974-31 JAN 75. Griffin, F.S. (Ordnance Research, Inc., Fort Walton Beach, Fla. (USA)). Apr 1965. Contract DAAB07-74-C-0375. 31p. NTIS $3.75.
BATTERY CHARGERS;NICKEL-CADMIUM BATTERIES; POWER;RELIABILITY;FABRICATION;DESIGN; PERFORMANCE TESTING

3119 (AD-A--009145) SOLID ELECTROLYTES AND PHOTOELECTROLYSIS. SEMIANNUAL TECHNICAL SUMMARY REPORT, 1 MAR--31 DEC 1974. *Goodenough, J.B.; Dwight, K. Jr.; Hong, H.Y.; Kafalas, J.A.; Mavroides, J.G.* (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). 31 Dec 1974. Contract F19628-73-C-0002. 32p. NTIS $3.75.
Three classes of cubic skeleton structures are explored for fast $Na^+$-ion transport for use as solid electrolytes in Na--S batteries. The cubic $KSbO_3$ structure consists of an $(SbO3)^-$ skeleton having [111] tunnels intersecting at origin and body-center positions. $NaSbO_3$ and $6NaSbO_3$.NaF disks of ca. 95 percent theoretical density give a $Na^+$-ion resistivity at 300°C of $rho_{300}$ approximately equal 13 ohm-cm and an activation energy E/sub a/ approximately equal 0.35 eV. Preliminary investigations of aluminosilicates having the carnegieite structure show promise, but a $rho_{300}$ approximately equals 610 ohm-cm is the best that has been achieved to date. The authors investigated the use of inexpensive, n-type hot-pressed $TiO_2$ powders as the working photocatalytic electrode for achieving photoelectrolysis of water. $TiO_2$ was selected because it is the lowest gap n-type semiconductor that, under illumination at an interface with water, evolves $O_2$ and does not decompose. A study of the physics and electrochemistry of a photoelectrolysis cell consisting of $TiO_2$ as the anode and platinized-

platinum as the cathode led to an optimization of the parameters of the system. (GRA)

3120 (AD-A--013364) BATTERY CHARGER PP-4126( )/U. FINAL REPORT, 1 JUL 1971--JUN 1974. Froeschle, T.A. (Bose Corp., Framingham, Mass. (USA)). Jul 1975. Contract DAAB07-71-C-0355. 97p. NTIS $4.75.

The performance data and design configuration of the PP-4126( )/U Battery Charger are delineated in this final report. Performance of the unit is summarized. Terminal performance and selected aspects of internal performance are considered. The internal system configuration of the battery charger is presented in block form. Functions of internal system blocks are discussed to define their design and behavior. Circuit components used to implement the systems blocks are identified. The PP-4126( )/U Battery Charger is designed to charge 6-, 12-, and 24-V dc batteries at selectable charging rates from 0.1 A dc to 12 A dc. The battery charger operates from MIL-STD-704 dc power sources in the range 22 V dc to 40 V dc. The battery charger structure is a finned housing with a removable cover. The cover contains the input power cable. The battery charger may be operated in any position.

3121 (AD-A--013931/1ST) ELECTROCHEMICAL IMPREGNATION OF SINTERED NICKEL STRUCTURES WITH CADMIUM USING CONSTANT CURRENT STEP AND ALTERNATING-CURRENT PULSE TECHNIQUES. INTERIM REPORT, JAN 1971--JUN 1974. Pickett, D.F.; Puglisi, V. (Spectrolab, Inc., Sylmar, Calif. (USA)). Jun 1975. Contract F33615-75-C-2012. 29p. NTIS $3.75.

Presented at the Electrochemical Society Meeting (146th), New York, N.Y., 14--17 Oct 1974..

Cadmium electrodes, made by impregnation of sintered nickel plaques with cadmium hydroxide by three electrochemical techniques followed by formation to cadmium, can be used as efficient electrodes in nickel--cadmium secondary cells yielding capacities as high as 9.8 Ah/in.$^3$ for aerospace secondary power. In flooded, negative limited cells electrodes made with a constant current step technique retained 80% of the original capacity after 750 cycles at 100% depth of discharge, over a varying temperature range from 21 to 43C. Alternating current pulse techniques, either symmetric or assymetric with respect to time, can yield electrodes with loadings of 2.1 to 2.3 g of $Cd(OH)_2$ per cubic centimeter of void. These electrodes show promise of being efficient for use in either flooded or starved electrolyte cells. (GRA)

3122 (AD-A--016721) CHARGE-DISCHARGE CYCLING OF DREO AIR ELECTRODES. Armstrong, W.A. (Defence Research Establishment, Ottawa, Ontario (Canada)). Sep 1975. 19p. (DREO-R--728). NTIS $3.25.

The effects of the composition of the electrode surface in contact with the electrolyte on the ability of an air cathode to withstand the rigours of oxygen evolution during charging have been investigated. Of the compositions studied, a sintered nickel surface containing silver, mercury, and PTFE (polytetrafluoroethylene) exhibited the lowest oxygen evolution potential. With a cycle regime consisting of 1 h oxygen reduction at 26 mA/sq cm followed by 2 h oxygen evolution at the same current density, the oxygen reduction potential decreased by 156 mV during 41 cycles. (GRA)

3123 (AD-A--016792) DEVELOPMENT OF A LOW-COST, LIGHT-WEIGHT, EFFICIENT, 1.5 KW INVERTER. FINAL REPORT. Suelzle, L.R.; Suelzle, J.S. (Delta Electronic Control Corp., Costa Mesa, Calif. (USA)). Sep 1975. Contract DAAK02-74-C-0388. 48p. (DECC--61098-003). NTIS $3.75.

The effective use of low-voltage dc power sources, such as fuel cells and batteries, requires efficient power conversion equipment to provide ac voltages. The development of a silent, light-weight inverter is discussed in this paper. The inverter is capable of delivering 1.5 kW into a 0.8-1.0 power factor load at 120 or 240 Vac and at 60 or 400 Hz. (GRA)

3124 (AD-A--017117) INVESTIGATION OF NEW CELL COMPONENTS FOR VENTED NICKEL--CADMIUM BATTERIES. TECHNICAL REPORT. Wagner, D.C. (Army Electronics Command, Fort Monmouth, N.J. (USA)). Nov 1975. 20p. (ECOM--4364). NTIS $3.50.

An investigation of new cell components for vented nickel--cadmium batteries shows that it is possible to prevent capacity loss due to crystal growth of cadmium and cadmium hydroxide by the addition of 1% indium hydroxide to the active cadmium powder. Cadmium anodes with 5% nickel hydroxide were found to be partially effective in resisting crystal growth. The investigation also shows that the low temperature performance of vented nickel--cadmium cells (-20F) with methacrylic acid-grafted polyethylene membranes, E-2291 (40/20), is equal to that of cells with standard cellophane membranes if the former are initially formed by means of an optimized pulse mode of charging (based on USAF data, the room temperature life of vented nickel--cadmium batteries with E-2291 separator is about five times greater than standard batteries with cellophane membranes). (GRA)

3125 (AD-A--017295) ELECTRON SPIN RESONANCE STUDY OF MOLYBDENUM TRIOXIDE-DOPED MANGANESE DIOXIDES. TECHNICAL NOTE. Gardner, C.L. (Defence Research Establishment, Ottawa, Ontario (Canada)). Oct 1975. 21p. (DREO-TN--75-24). NTIS $3.50.

The structure and solid state properties of manganese dioxides are of interest because of the use of this oxide as a depolarizer in a variety of battery systems. Electron spin resonance spectroscopy (ESR) has been used to study a series of molybdenum oxide-doped manganese dioxides. The ESR results show that both the surface area of the manganese dioxide as well as the Mn(2+) concentration in the material depends on the amount of molybdenum oxide added. Determination of these quantities is of interest since the work of Valand indicates that they are related to the electrochemical characteristics of the manganese dioxides. (GRA)

3126 (AD-A--018478) FABRICATION AND INVESTIGATION OF NICKEL--ALKALINE CELLS. PART II. ANALYSIS OF ETHANOLIC METAL NITRATE SOLUTIONS USED IN FABRICATION OF NICKEL HYDROXIDE ELECTRODES. TECHNICAL REPORT, JUN 1972--JAN 1975. Pickett, D.F. (Air Force Aero-Propulsion Lab., Wright-Patterson AFB, Ohio (USA)). Oct 1975. 20p. (AFAPL-TR--75-34-Pt-2). NTIS $3.50.

See also Part I dated Oct 1975, AD-A--018517.

Ethanol solutions containing nickel and cobalt nitrates are used in a recently developed process for electrodeposition of nickel and cobalt hydroxides inside nickel sinters (D.F. Pickett, U.S. Patent 3,827,911 (1974)). Nickel hydroxide electrodes, resulting

from this technique, have demonstrated superior performance over electrodes commonly used in aerospace Ni--Cd batteries (V. J. Puglisi, H. N. Seiger, and D. F. Pickett, Proceedings of the 9th IECEC Conference San Francisco, CA, Aug 1974, pp. 873-879). In order to control quality of these new electrodes several methods of analysis for impregnating solutions were developed. These methods employ use of techniques such as gas chromatography, atomic absorption spectrophotometry, and visual spectrophotometry for individual component analysis. (GRA)

3127 (AD-A--018517) FABRICATION AND INVESTIGATION OF NICKEL--ALKALINE CELLS. PART I. FABRICATION OF NICKEL-HYDROXIDE ELECTRODES USING ELECTROCHEMICAL IMPREGNATION TECHNIQUES. TECHNICAL REPORT, 1 JAN 1971--1 JAN 1974. Pickett, D.F. (Air Force Aero-Propulsion Lab., Wright-Patterson AFB, Ohio (USA)). Oct 1975. 77p. (AFAPL-TR--75-34(Pt.1)). NTIS $5.00.

See also Part II dated Oct 1975, AD-A--018478.

Several electrochemical impregnation techniques for deposition of active nickel hydroxide inside nickel sinters were investigated. The most favorable means of impregnation appears to be deposition from alcoholic nitrate solutions. Formation cycling of electrodes made from the various techniques has been performed using 20 to 50% overcharge for 10 to 30 cycles. Some electrodes show capacities as high as 9.5 ampere-hours per cubic inch after these cycles. The alcohol process has been scaled to pilot production, and several 20 to 25-AH vented nickel--cadmium cells were constructed using cadmium electrodes fabricated from another electrochemical technique. These cells show vastly improved charge acceptance, at a wide temperature range, over state-of-the-art vented aircraft cells and improved cycle life at high temperatures and deep depths of discharge. (GRA)

3128 (AD-A--019580) ANALYSIS OF POROUS ELECTRODES WITH SPARINGLY SOLUBLE REACTANTS IV. APPLICATION TO PARTICULATE BED ELECTRODE: AG/AGCL SYSTEM. TECHNICAL REPORT. Katan, T.; Gu, H.; Bennion, D.N. (Lockheed Missiles and Space Co., Palo Alto, Calif. (USA). Lockheed Palo Alto Research Lab.). 15 Jan 1976. Contract N00014-73-C-0397. 32p. (LMSC-D--454335). NTIS $4.00.

Prepared in cooperation with California Univ., Los Angeles. School of Engineering and Applied Science.

Experiments were conducted to characterize critical processes affecting performance of totally-immersed, porous, secondary electrodes. Reaction product (AgCl) distribution and polarization-time behavior under galvanostatic conditions determined experimentally are in good accord with a recently developed mathematical model. (GRA)

3129 (AD-A--022199) SOLID ELECTROLYTES: ALKALI-ION TRANSPORT IN SKELETON STRUCTURES. SEMIANNUAL TECHNICAL SUMMARY NO. 2, 1 JUL--31 DEC 1975. Goodenough, J.B.; Hong, H.Y-P.; Kafalas, J.A.; Dwight, K. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). 31 Dec 1975. Contract F19628-76-C-0002. 40p. NTIS $4.00.

We have demonstrated the existence of fast, three-dimensional $Na^+$-ion transport in the system $Na_{1+3y}Zr_2(P_{1-y}Si_yO_4)_3$ for y less than or equal to 1. At 300°C, the operating temperature of a Na--S battery, the resistivity (5 ohms-cm) for $Na^+$-ion transport in $Na_3Zr_2PSi_2O_{12}$ is competitive with the best beta-alumina. The activation energy for $Na^+$-ion transport, about 0.26 eV, is about 0.08 eV higher than that of beta-alumina, this compound is thus superior to the best beta-alumina at temperatures greater than 300°C, inferior, at lower temperatures. The compound is stable in molten sodium and can be sintered at 1250°C. We have elected to concentrate on the fabrication of ceramic cups suitable for cell construction in order to test the chemical stability of this compound under the operating conditions of a Na--S cell. (auth)

3130 (AD-A--022467) DEVELOPMENT OF ZINC ELECTRODES AND INORGANIC SEPARATORS FOR LARGE SIZE SILVER--ZINC BATTERIES. FINAL TECHNICAL REPORT, 4 MAR 1974--31 OCT 1975. Charkey, A. (Energy Research Corp., Bethel, Conn. (USA)). 17 Mar 1976. Contract N00024-74-C-5262. 21p. NTIS $4.00.

During the nineteen-month period of this contract, both 40-Ah and 850-Ah (NR-1) size silver--zinc cells were designed, fabricated, and tested to evaluate improved zinc electrode structures and inorganic separators developed by ERC. The 40-Ah-cell groups have completed cycling and have achieved 150 to 300 cycles depending on the cell construction. The NR-1 batteries have completed 150 to 300 days of testing on both float and deep discharge regimes with the testing continuing. Three NR-1 and three DSRV (525-Ah) cells have been fabricated with the most promising design and have been delivered to NAD-Crane for life test evaluation. The most promising design from data obtained in both 40-Ah and 850-Ah cells appears to be a combination of FSC and ERC 2002 inorganic separator with KT separator on the negative electrode. The various negative plate additives investigated did improve performance in cells with FSC separators, but did not show an additional improvement when tested in cells with inorganic and FSC separators in combination. (GRA)

3131 (AD-A--024658) SOLID ELECTROLYTE BATTERY MATERIALS. TECHNICAL REPORT. Huggins, R.A. (Stanford Univ., Calif. (USA). Center for Materials Research). 31 Dec 1975. Contract N00014-75-C-1056. 128p. (CMR--76-7). NTIS $6.00.

See also report dated 31 Mar 1975, AD-A--012098.

This work has three major objectives: (1) to investigate a novel technique for producing beta-alumina solid electrolytes for use in sodium--sulfur cells, (2) to search for new fast ion conducting materials for protons or alkali metal ions, and (3) to examine certain mixed conductor materials for potential application in electrodes for advanced secondary battery designs. (GRA)

3132 (AD-A--025202) STRUCTURE OF LITHIUM--BORON ALLOYS AND THEIR PERFORMANCE AS POTENTIAL ANODES FOR HIGH POWER MOLTEN SALT BATTERIES. PROGRESS REPORT, 1 AUG 1974--30 JUN 1975. James, S.D.; DeVries, L.E. (Naval Surface Weapons Center, Silver Spring, Md. (USA)). 1 Mar 1976. 29p. (NSWC/WOL-TR--76-22). NTIS $4.00.

Anodic discharge curves in the LiCl--KCl eutectic melt have been obtained for two lithium--boron alloys (70 and 80 wt % Li) between 673 and 873 K (400 and 600 C) and from 2 to 8 A/sq cm. The behavior of Li contained in wicks of porous Ni was also studied for comparison. Calculated Li contents for Li--B alloy anodes, at the main break in curvature of discharge curves, clustered closely around 0.67

mole fraction Li. This is considered strong evidence for the existence of a compound $Li_2B$ in this alloy system. Between 748 and 873 K (475 and 600 C) and up to at least 8 A/sq cm, there are no diffusional limitations to the anodic extraction of Li from the Li--B alloys. The shape of discharge curves, the lack of anodic diffusional limitation, and the longer low-V plateaus of the alloy richer in Li are consistent with the following picture of the discharge process. The discharging material behaves like a sponge of solid $Li_2B$ compound containing a Li-rich, Li--B liquid alloy, probably a conjugate phase to the $Li_2B$ compound. Lithium anodizes into the melt at constant V out of this liquid alloy until it is wholly transformed to solid $Li_2B$. This process constitutes the main plateau of alloy discharge curves. At this point (the main break in discharge curves) voltage rises to values where tighter-bound Li can be anodized out of the decomposing compound. The Li--B alloy electrodes are markedly superior to the Li--Ni wicks, both in gravimetric coulombic capacity and in the ability to retain Li at high temperatures. Useful coulombic capacities of the Li--B alloys ranged up to 7700 coulombs per g of (Li+B) at about 3 V versus a chlorine reference electrode. (GRA)

3133 (AD-A--026551) ENGINEERING ANALYSIS OF SHAPE CHANGE IN ZINC SECONDARY ELECTRODES. FINAL REPORT NOV 73--NOV 75. Choi, K.W.; Hamby, D.; Bennion, D.N.; Newman, J. (California Univ., Los Angeles (USA). School of Engineering and Applied Science). Mar 1976. Contract F33615-74-C-2004. 133p. (UCLA-ENG--7634). NTIS $6.00.

Shape change, the redistribution of active material over the zinc electrode surface as a result of cell cycling, is hypothesized to be caused by convective flows driven primarily by membrane pumping. A mathematical model is formulated based on the convective flow hypothesis for the zinc--silver oxide secondary cell and tested by actual cell experiments. The numerical solutions predict redistributions of zinc material over the zinc electrode, fluid flow rates, variations of current distribution, and cell potential with the number of cycles. These numerical calculations are compared quantitatively to the experimental observations. The results show that shape change can be eliminated if the convective flow in the zinc electrode compartment parallel to the electrode surface is stopped. (auth)

3134 (AD-A--027694) ELECTRODE MECHANISMS USING REFLECTION AND ELECTRON SPECTROSCOPY. FINAL REPORT 15 JAN 1972--14 JAN 1976. Winograd, N. (Purdue Univ., Lafayette, Ind. (USA). Dept. of Chemistry). Jun 1976. 30p. NTIS (US Sales Only).

The general objectives of our AFOSR research have emphasized the development of various spectroscopic methods in characterizing electrochemical reaction mechanisms. The reason for exploring spectroscopic methods for investigating electrode processes stemmed from a general lack of progress from monitoring the relatively unspecific parameters of current, potential and charge. To date, these studies have involved the development of the internal reflection spectroscopic (IRS) technique at optically transparent electrodes (OTE's) to monitor in situ surface electrode reactions. Reflection changes induced both by the diffusion of light absorbing species in solution, and by the alteration of the optical constants associated with the formation of electrode films have been observed. In addition, we initiated in 1971 the first experiments utilizing electron spectroscopy for chemical analysis (XPS or ESCA) for identifying the nature of surface films. Since that time we have been concerned with developing XPS as a mechanistic aid in following electrode reactions, primarily those where surface oxide films alter the electronic properties of the electrode surface. (auth)

3135 (AD-A--031866) NICKEL/CADMIUM AIRCRAFT BATTERIES: HIGH RATE DISCHARGE EQUIPMENT. TECHNICAL NOTE. Feldman, K.; Haines, R.L.; LePage, W. (Defence Research Establishment, Ottawa, Ontario (Canada)). Sep 1976. 25p. (DREO-TN--76-22). Dep. NTIS, PC A02/MF A01.

Abstract in French.

Factors that are not of major significance in low rate battery discharges become quite important when a battery is used to crank an aircraft turbine engine. Apparatus was designed and built to facilitate the study of nickel/cadmium aircraft batteries when used in this and other high rate applications. Maximum discharge rates of 1000 amperes or more are possible with 24-volt batteries. Load configurations may be readily modified. Discharge profiles are simulated by use of fixed load steps which may be timed either automatically or manually. This document describes the equipment and gives instructions for its use. (auth)

3136 (AD-A--032342) SOLID ELECTROLYTES: ALKALI-ION TRANSPORT IN SKELETON STRUCTURES. SEMIANNUAL TECHNICAL SUMMARY REPORT, 1 JAN--30 JUN 1976. Goodenough, J.B.; Hong, H.Y.P.; Kafalas, J.A.; Dwight, K. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). 30 Jun 1976. Contract F19628-76-C-0002. 22p. NTIS, PC A02/MF A01.

See also report dated 31 Dec 1975, AD-A--022199.

A new three-dimensional $K^+$-ion conductor, K/sub 1.9/Mg/sub 0.95/Si/sub 1.05/$O_4$ was identified. Its resistivity at 300C is 28 ohm-cm, less than one-fourth the value for the best potassium β-alumina. More definitive measurements have been made of the $Na^+$-ion transport in $Na_3Zr_2Si_2PO_{12}$ (NASICON). Its resistivity at 300C is 3 ohm-cm, compared with 4 ohm-cm for β''-alumina. Moisture tests have shown that NASICON is insensitive to water vapor. Static tests in molten $Na_2S_4$ for 10 days at 400C indicate chemical stability; similar tests in molten Na and dynamic tests in a Na--Na cell are in progress. Conclusive evaluation of stability awaits the preparation of additional test specimens. (GRA)

3137 (AD-A--033764) STUDY OF THE CYCLIC PERFORMANCE OF SUBMARINE TYPE LEAD--ACID STORAGE BATTERIES BY EXAMINATION OF THE POSITIVE PLATE STRUCTURES. Pokorny, J.L. Jr. (Naval Postgraduate School, Monterey, Calif. (USA)). Sep 1976. 259p. NTIS, PC A12/MF A01.

Thesis.

The microstructures of the active material of the positive plate of submarine type storage batteries were studied, using scanning electron microscopy, as the batteries were cycled on a deep cycle routine. It is seen that capacity loss of these batteries can be directly related to the formation of a coralloid structure within the active material of the positive plate in both lead-antimony and lead-calcium grid batteries. It is proposed that this coralloid structure also leads to active material shedding which is observed at the end of the battery life. The ability of thick plate lead-calcium grid batteries to be successfully

operated on a deep cycle routine is related to a reserve of active material retained within the positive plate as lead sulfate, which is eventually transformed into $PbO_2$ to maintain the capacity of the battery.

3138 (AD-A--034074) BASIC AND APPLIED RESEARCH IN MATERIALS. ANNUAL TECHNICAL REPORT, 1 JUN 1975--30 JUN 1976. Wagner, J.B. Jr. (Northwestern Univ., Evanston, Ill. (USA). Materials Research Center). 30 Jun 1976. Contract N00014-75-C-1116. 18p. NTIS, PC A02/MF A01.

This report describes the research carried out in two major areas: 1) Materials for Energy Storage and 2) Heterogeneous Catalysis. Materials for Energy Storage: The discovery of new types of solid electrolytes (such as beta alumina, $RbAg_4I_5$, copper and silver halides and stabilized zirconia) with large values of ionic conductivity at relatively low temperatures has enhanced the prospect of developing battery systems possessing a high energy storage-to-weight ratio, high power output capability, long life in service, efficiency in charge-discharge characteristics and the capability of being constructed from inexpensive, readily obtainable materials. Heterogeneous Catalysis: a number of the most important heterogeneous catalysts consist of tiny crystallites of metal supported upon a carrier such as silica or alumina. The support leads to a greater metallic surface area per gram of metal and permits use of the catalyst at temperatures up to 500 C without rapid sintering. However, relatively little is known of the exact nature of the crystallites (including the nature of their attachment to the support), the effect of the support upon the catalyst behavior, the effect of the method of catalyst preparation upon catalytic activity. It is the purpose of this project to provide some resolution of these problems.

3139 (AD-A--036071) CHARGING EQUIPMENT, MOBILE (CEM). FINAL REPORT OCT 1972--NOV 1974. Basehore, R.; Nagy, S. (Army Engineer Topographic Labs., Fort Belvoir, Va. (USA)). Jun 1976. 36p. (ETL--0089). NTIS PC A03/MF A01.

This report covers the design, fabrication, test, and operation of the Charging Equipment, Mobile (CEM) which provides a mobile battery charging capability to field units. The design and fabrication was performed in house at the U.S. Army Engineering Topographic Laboratories to support the Long Range Position-determining System (LRPDS). The CEM has been used specifically to recharge BB-451/U, silver-zinc batteries used with LRPDS backpackable ground units. However, the dialable voltage cutoff in the battery charger will permit recharge of silver-cadmium and lead-acid batteries, among others. The equipment was used extensively in the field tests of the LRPDS for charging BB-451/U batteries at 2.25 amperes with a cutoff at 32 volts. Although activation of the BB-451/U batteries is a slow and painstaking operation, nine batteries were easily and reliably recharged at one time. Besides the operational tests, a safety evaluation and a road test were made by the U.S. Army Test and Evaluation Command. No unusual hazards were found, and there was no evidence of physical damage after runs over the Munson Road at the Aberdeen Proving Ground.

3140 (AD-A--036290) THE CYCLIC VOLTAMMETRY OF LEAD AND LEAD--ANTIMONY BATTERY GRID ALLOY IN AQUEOUS SULPHURIC ACID AT 25 TO -40 C. Chang, T.G.; Wright, M.M.; Valeriote, E.M.L. (Defence Research Establishment, Ottawa, Ontario (Canada)). Feb 1977. 34p. (DREO-R--753). NTIS PC A03/MF A01.

The cyclic voltammetry of lead and antimonial lead has been studied in 1.25 sp gr $H_2HO_4$, at 25 C to -40 C, at sweep rates of 0.42 to 42 mV/S, between hydrogen and oxygen evolution and over narrower regions of potential. The latter, coupled with systematic variation of the positive or negative reversal potential, has revealed peak shifting and hysteresis effects which give further insight into the nature of the reactions of the lead-acid battery. The significance of the results to the improvement of charge acceptance at low temperatures is discussed.

3141 (AD-A--038754) DEVELOPMENT OF AN IMPROVED SEPARATOR MATERIAL FOR ALKALINE SILVER--ZINC BATTERIES. PRELIMINARY STUDY DEC 75--MAY 76. Kilroy, W.P.; Duffy, J.V. (Naval Surface Weapons Center, Silver Spring, Md. (USA)). 1 Feb 1977. 27p. (NSWC/WOL/TR--76-135). NTIS PCA03/MF A01.

This work was a preliminary investigation to determine if polyphenylquinoxaline (PPQ) or a codispersed mixture of polyvinylpyrrolidone (PVP) with PPQ could be used to replace cellophane as a separator in the zinc--silver oxide battery. The primary purpose was to compare its dimensional and chemical stability with cellophane and to determine if methods could be developed to lower its high inherent electrical resistance. Dimensional measurements were made in 45% KOH at 298 K (25 C) and 353 K (80 C). Chemical stability to oxidation was observed in KOH solution saturated with silver oxide at 353 K. In an effort to lower the resistance of these thin film membranes, various methods were studied to develop porosity. Included among these were extraction of the PVP in boiling water, pyrolysis of the PVP, swelling of the films with phenol, and precipitation of the PPQ from acetone. Increasing the molecular weight of the PVP appears very promising, and additional studies are recommended since these polymers have good potential use as separators.

3142 (AD-A--039335) NICKEL/CADMIUM AIRCRAFT BATTERIES: RAPID ELECTROLYTE EXCHANGE TECHNIQUE. TECHNICAL NOTE. Feldman, K.; Hayashi, R.M. (Defence Research Establishment, Ottawa, Ontario (Canada)). Apr 1977. 15p. (DREO-TN--77-8). NTIS PC A02/MF A01.

The potassium hydroxide electrolyte in nickel/cadmium aircraft batteries may become increasingly more contaminated by carbonate with battery use. When the carbonate concentration exceeds certain limits, it is advisable to exchange the electrolyte. However, most of the electrolyte in a cell is soaked into the separator materials and plate pores, and is held in the pack, so only a small portion of it may be poured out. Repeated removal and replacement of these small amounts can accomplish the desired exchange if the clean added electrolyte is adequately mixed with the contaminated electrolyte each time. In the normal procedures, mixing is accomplished by discharging and recharging the battery after each small exchange and hence is very time consuming. This paper discusses the various factors involved and presents a vacuum technique for mixing the added with the retained electrolyte in each cell. The method presented reduces the time required for the above operation from a week or more to a day or two. (Author)

3143 (AD-A--039518) ABSORPTION AND DESORPTION RATES OF $H_2$ AND $D_2$ FOR $LANI_5$, $LACO_5$, $LANI_2CO_3$, AND FETI. INTERIM REPORT. Meilleur, C.P.; Martinelli, M.R.; Mayer, S.W. (Aerospace Corp., El Segundo, Calif. (USA). Chemistry and Physics Lab.). 19 Apr 1977. Contract F04701-76-C-0077. 18p. (TR--0077(2270-10)-2). NTIS PC A02/MF A01.

Rates of $H_2$ absorption and desorption were measured for $LaNi_5$, $LaCo_5$, $LaNi_2CO_3$, and FeTi in order to examine the limitations of these alloys for storing $H_2$ in high-power Ni-$H_2$ satellite batteries. If the $H_2$ absorption and desorption rates are sufficient, $H_2$ storage in the alloys could increase the energy density and decrease the volume of Ni-$H_2$ spacecraft batteries. The rate measurements showed that the quantity of $H_2$ absorbed or desorbed was linearly dependent on the square root of time for all four alloys. This rate law indicated that the rate-controlling step was hydrogen atom diffusion through an adherent hydride layer to the alloy surface. The activation energy for desorption from $LaNi_5$ was 4.5 +- 0.5 kcal. Even at 0.4 C, the $H_2$ absorption and desorption rates were sufficient that batteries could be charged and dishcarged in less than 30 min. Rates for $D_2$ were also determined and found to be lower than for $H_2$. The use of $LaCo_5$ and $LaNi_2Co_5$ permitted even lower pressures than those needed with $LaNi_5$ for $H_2$ storage in Ni-$H_2$ satellite batteries. (Author)

3144 (AD-A--039735) NICKEL/CADMIUM AIRCRAFT BATTERIES: MULTICHANNEL GASSING-RATE METER. TECHNICAL NOTE. Feldman, K.; Haines, R.L. (Defence Research Establishment, Ottawa, Ontario (Canada)). Mar 1977. 24p. (DREO-TN--77-5). NTIS PC A02/MF A01.

The instrument described is used to assess the state of health of separators in nickel/cadmium aircraft batteries, and thus to permit removal from service of those cells which may be expected to fail catastrophically in the near future. Twenty channels are provided to permit simultaneous observation of all cells in a complete battery. Each channel measures the rate of emission of gas from one cell during overcharge by means of the pressure build up in a chamber from which the gas escapes via a suitable orifice. Construction, calibration and cleaning are discussed.

3145 (AD-A--039899) SOLID ELECTROLYTE BATTERY MATERIALS. TECHNICAL REPORT. Huggins, R.A. (Stanford Univ., Calif. (USA). Center for Materials Research). 30 Nov 1974. Contract N00014-67-A-0112-0075. 145p. (CMR--74-16). NTIS PC A07/MF A01.

This is the third technical report relating to work on Solid Electrolyte Battery Materials. During the past 18 months our efforts have had two major aims: one is to develop a novel technique for producing beta alumina solid electrolytes for use in the sodium-sulfur cell. The other is to search for new fast ion conducting materials for lithium and potassium ions, as well as to examine mixed conductor materials for potential application as electrodes in advanced secondary battery designs. The details and results of our efforts for the first year are presented in Technical Report No. 2. The present report covers the first six months of effort in the second year.

3146 (AD-D--003275) BATTERY WEDGE FOR SUBMARINES OR OTHER INSTALLATIONS. Mongillo, A.V. (Environmental Protection Agency, Denver, Colo. (USA)). 6 Oct 1976. 15p. NTIS, PC A02/MF A01.

The patent application relates to a wedge assembly for spacing apart batteries which permits a complete range of operation with all components remaining intact in their assembled form. A central or inner wedge having a plurality of identical wedge sections is movable between a pair of outer wedges or side plates having mating inner sections and a planar outer surface. Wedging action is produced by torquing a bolt secured to the outer wedges and threaded through a nut secured in the inner wedge. The wedging components are held together and in alignment by screws attached to the inner wedge and guided through slots formed in the outer wedges.

3147 (AD-D--003476) DIGITAL AMP-HOUR MONITOR. Privee, J.A. (Environmental Protection Agency, Denver, Colo. (USA)). 13 Jul 1976. 53p. NTIS, PC A04/MF A01.

An amp-hour monitor is provided to determine the power expended by a marine battery power supply system. Digital processing circuitry monitors a selected battery system and provides a readout of the power expended using a digital display. Additionally, a display of on-line current being drawn from the individual battery packs is displayed.

3148 (ANL--76-8, pp B.2-B.12) STRUCTURAL, THERMODYNAMIC, AND KINETIC PROPERTIES OF SOLID ELECTRODES. Worrell, W.L.; Nagelberg, A.S. (Univ. of Pennsylvania, Philadelphia). 1976.

From Battery workshop; Argonne, Illinois, USA (21 Mar 1976).

Proceedings of the symposium and workshop on advanced battery research and design, March 22--24, 1976.

One major impediment to the development of useful reversible batteries is the lack of suitable solid electrode materials. After a brief review of electrochemical principles, the characteristics of an ideal solid electrode are summarized. Solid compounds which appear to possess many of these characteristics are the alkali metal intercalated dichalcogenides of the Group IV and V transition metals. The preparation and crystal structures of these intercalated compounds are reviewed. A method for estimating maximum values of the alkali metal chemical potential in these compounds is described. Knowledge of the compositional variation of the chemical potential and diffusivity of the alkali metal in these compounds is necessary to assess quantitatively their usefulness as cathode materials. Electrochemical cell techniques which can be used to obtain such data are briefly summarized. 4 figures, 4 tables.

3149 (ANL--76-8, pp B.13-B.24) SUBSTRUCTURE AND PROPERTIES OF SODIUM BETA ALUMINA SOLID ELECTROLYTES. De Jonghe, L.C.; Hsieh, M.Y. (Cornell Univ., Ithaca, NY). 1976.

From Battery workshop; Argonne, Illinois, USA (21 Mar 1976).

Proceedings of the symposium and workshop on advanced battery research and design, March 22--24, 1976.

The microstructure and properties of sodium beta alumina solid electrolytes are discussed. Improved sinterability of commercial beta alumina powder was achieved by addition of small amounts of the $Na_2O$--$Al_2O_3$ eutectic. Complex crystallographic faults and subgrain boundaries were found that can affect the microscopic homogeneity of the ionic current flow during d.c. ionic conduction. The effects of CaO and $SiO_2$ additions on microstructure and ionic conductivity are described. 10 figures.

3150 (ANL--76-8, pp B.25-B.40) OPTIMIZATION OF MGO-DOPED BETA-$AL_2O_3$ WITH RESPECT TO ELECTRICAL CONDUCTIVITY. Haar, W.; Fischer, W.; Kleinschmager, H.; Weddigen, G. (Brown, Boveri and Cie, Mannheim, Ger.). 1976.
From Battery workshop; Argonne, Illinois, USA (21 Mar 1976).
Proceedings of the symposium and workshop on advanced battery research and design, March 22--24, 1976.
The composition of MgO-stabilized β-alumina was varied in the following ranges: 7.3 ... 9.3 weight-% $Na_2O$, 1 ... 4 weight-% $Na_2O$, 86.7 ... 91.7 weight-% $Al_2O_3$. Rod-shaped specimens were prepared from calcined and ballmilled powder, isostatically pressed and sintered at temperatures between 1550 and 1800°C. A four-electrode method was applied to measure the electrical conductivity in the frequency range 100 Hz to 100 kHz by using painted graphite electrodes contacted to platinum foils. Both the conductivity and the $\beta''$-$Al_2O_3$ content increased with increasing $Na_2O$ content. Furthermore, at a constant $Na_2O$ concentration the conductivity reaches a maximum at a certain MgO content depending on the $Na_2O$ concentration. Conductivity values up to $0.3^{-1}$ $(\Omega cm)^{-1}$ at 300°C were obtained. Some preliminary results of lifetime tests are given. 15 figures, 1 table.

3151 (ANL--76-8, pp B.41-B.49) SEPARATORS FOR LITHIUM ALLOY--IRON SULFIDE FUSED SALT BATTERIES. Walker, R.D. Jr. (Univ. of Florida, Gainesville); Cheng, C.C.; Battles, J.E.; Mathers, J.P. 1976.
From Battery workshop; Argonne, Illinois, USA (21 Mar 1976).
Proceedings of the symposium and workshop on advanced battery research and design, March 22--24, 1976.
Separators woven from boron nitride roving are reasonably satisfactory for these batteries, but they are expensive and somewhat limited as to their mechanical and electrical characteristics. Paper-like separators can be made from BN, $Y_2O_3$, or $LiAlO_2$ fibers or their mixtures, but they are very fragile and mechanically unstable. Organic and inorganic binders can overcome some of these limitations, but they generally either react with the anode or they are themally unstable at battery temperatures. The addition of chrysotile asbestos fibers in relatively small proportion increases strength and mechanical stability markedly, but the long-term stability of asbestos in the battery environment is somewhat in question. Preliminary cell tests suggest that the asbestos may disintegrate after a few cycles for reasons which are not clear at present. Strength and other properties can be further improved by adding substantial proportions of powders, such as BN, $Y_2O_3$, $LiAlO_2$, or MgO, to the fiber mixture. MgO produces very strong sheets but these tend to crack easily. A cell testing program is currently in progress. 2 tables.

3152 (ANL--76-8, pp B.50-B.73) MATERIALS DEVELOPMENT IN THE LITHIUM--ALUMINUM/IRON SULFIDE BATTERY PROGRAM AT ARGONNE NATIONAL LABORATORY. Myles, K.M.; Mrazek, F.C.; Smaga, J.A.; Settle, J.L. (Argonne National Lab., IL). 1976.
From Battery workshop; Argonne, Illinois, USA (21 Mar 1976).
Proceedings of the symposium and workshop on advanced battery research and design, March 22--24, 1976.
The materials development effort in the lithium--aluminum/iron sulfide battery program at the Argonne National Laboratory traverses a spectrum of endeavors that includes design and fabrication, compatibility evaluation, and postoperative examination of various cell components. A brief historical overview of the effort is presented, but emphasis is placed on current areas of activity, with a mention of anticipated future plans. The major topics discussed are the development of electrical feedthroughs, the compatibility of negative- and positive-electrode components with the cell environment, the use of the postoperative examination as an aid in cell design, the study of the Li--Al phase diagram, and the development of positive-electrode current collectors. 10 figures, 5 tables.

3153 (ANL--76-8, pp B.74-B.84) WETTABILITY OF HIGH-TEMPERATURE CELL SEPARATORS BY MOLTEN SALT. Eberhart, J.G. (Argonne National Lab., IL). 1976.
From Battery workshop; Argonne, Illinois, USA (21 Mar 1976).
Proceedings of the symposium and workshop on advanced battery research and design, March 22--24, 1976.
In lithium--aluminum/iron sulfide cells, the ceramic separator and particle retainer materials must be wet and penetrated by the molten LiCl--KCl electrolyte so that lithium ions can easily pass through these porous materials during discharge and charge. Measurements were made of the wettability of solid surfaces of these materials. Molten-salt contact angles were observed to be nonwetting while advancing and wetting while receding. The hysteresis was quite large. Determinations were also made of the molten salt penetrability of various fabrics and papers composed of these materials. These studies suggested procedures which assure salt penetration and permeation through the materials that are difficult to wet. 6 figures, 1 table.

3154 (ANL--76-8, pp B.99-B.116) OVERCHARGE STUDIES OF THE $FES_2$ ELECTRODE IN $LI/FES_2$ CELLS. Tomczuk, Z.; Hollins, R.E.; Steunenberg, R.K. (Argonne National Lab., IL). 1976.
From Battery workshop; Argonne, Illinois, USA (21 Mar 1976).
Proceedings of the symposium and workshop on advanced battery research and design, March 22--24, 1976.
The overcharge reaction of the $FeS_2$ electrode in $Li/FeS_2$ cells was studied by operating five cells to successively higher charge cutoff voltages and also by cyclic voltammetry. The results indicated that increasing the charge cutoff voltage increases the porosity in the $FeS_2$ electrode while decreasing the coulombic efficiency. The products of the overcharge were identified as ferrous chloride and sulfur. The cyclic voltammetry results indicated that the reaction is irreversible and diffusion-limited. A reduction mechanism consistent with experimental data is proposed. 8 figures, 4 tables.

3155 (ANL--76-8, pp B.117-B.137) REVIEW OF THE KINETICS OF THE SULFUR ELECTRODE IN MOLTEN SODIUM POLYSULFIDE. Ludwig, F.A. (Ford Motor Co., Dearborn, MI). 1976.
From Battery workshop; Argonne, Illinois, USA (21 Mar 1976).
Proceedings of the symposium and workshop on advanced battery research and design, March 22--24, 1976.
The electrode kinetics of the sulfur electrode in a pure melt of a salt of the redox system was investigated in connection with the development of the sodium--sulfur battery. It

was found that a $Na_2S_4$ melt consists primarily of $Na^+$ and $S_4^{--}$ ions, that the entire anion concentration is electroactive, that $S_2^{--}$ ion is the product of reduction at the electrode, and that there is no chemical reaction prior to this charge transfer reaction. It is also shown that the usual electroanalytical equations for diffusion control are obeyed within a few percent, with experimental errors within a few percent. The salient feature of all voltage sweep diagrams is a clear distinction between the S/S--/sub x/, the S--/sub x//$S_2^{--}$, and the S--/sub x//S-- reactions. In addition, the diagrams always show a final rise of current at large polarizations. Cathodically, this rise represents the deposition of Na. The final rise on the anodic side most probably indicates that it is sulfur that is oxidized to positive S ions. 14 figures, 1 table. (RWR)

3156 (ANL--76-8, pp B.152-B.153) CATHODE SYSTEMS FOR ALUMINUM--MOLTEN CHLOROALUMINATE BATTERIES. Mamantov, G.; Marassi, R.; Chambers, J.Q. (Univ. of Tennessee, Knoxville). 1976.
From Battery workshop; Argonne, Illinois, USA (21 Mar 1976).
Proceedings of the symposium and workshop on advanced battery research and design, March 22--24, 1976.
The electrochemical characterization of several potential cathode systems for batteries using low-melting-point (less than 200°C) molten chloroaluminate ($AlCl_3$--NaCl mixtures) solvents was investigated. These melts offer several advantages for molten salt battery applications. The following potential cathode systems in these melts were studied: fluorinated graphite with different F content (CF/sub 0.85--1/), binary and ternary intercalation compounds (e.g. C--$WCl_6$ and C--$AlCl_3$--Cl), several quinones, and positive iodine and sulfur cations. The latter was the most promising. The electrochemical behavior of S and sulfide in molten $NaAlCl_4$ saturated with NaCl was investigated at different temperatures and with different electrode materials. The mechanism for the electrochemical oxidation of S apparently inv lves a complex set of charge transfer and chemical steps. (RWR)

3157 (ANL--76-8, pp B.154-B.166) STUDIES ON THE NEGATIVE ALLOY ELECTRODE. Ito, Y.; Matsunaga, M.; Yoshizawa, S. (Kyoto Univ., Sakyo, Japan). 1976.
From Battery workshop; Argonne, Illinois, USA (21 Mar 1976).
Proceedings of the symposium and workshop on advanced battery research and design, March 22--24, 1976.
Alkali metal alloy is a promising negative electrode for a high-performance battery. Energy density and power density of such alloy electrodes can be discussed in relation to the phase diagram. Liquid alloy is preferable when cycle life is exaggerated, and solid alloy is preferable from the cell design aspect. Experimental data to support such conclusions are shown in this paper. 15 figures, 3 tables.

3158 (ANL--76-8, pp B.167-B.175) LITHIUM--SILICON ELECTRODES FOR THE LITHIUM--IRON SULFIDE BATTERY. McCoy, L.R.; Lai, S. (Rockwell International, Canoga Park, CA). 1976.
From Battery workshop; Argonne, Illinois, USA (21 Mar 1976).
Proceedings of the symposium and workshop on advanced battery research and design, March 22--24, 1976.
Lithium--silicon negative electrodes are being developed at Atomics Internatonal for use in high-temperature (400°C) lithium--iron sulfide load-leveling batteries. These electrodes discharge in a series of voltage plateaus with an average open-circuit potential of 230 mV positive to lithium. Four alloy compositions, solid at temperatures below approximately 600°C, were identified. Thermodynamic data for the formation of each composition was calculated. Light-weight structures providing current collection as well as support and containment for the alloys were found. These electrodes have specific capacities in excess of 0.80 Ah/$cm^3$, and 80 percent or more utilization of the theoretical capacity of the active materials was obtained at current densities (40 mA/$cm^2$) of interest to load-leveling service with electrodes 0.64 cm thick. Optimization studies are being made to determine the effect of structural variables and specific capacity loading on electrode performance. 4 figures, 3 tables.

3159 (ANL--76-8, pp B.189-B.198) STUDIES ON THE BIPOLAR LIQUID METAL ELECTRODE. Ito, Y.; Goto, M.; Yoshizawa, S. (Kyoto Univ., Sakyo, Japan). 1976.
From Battery workshop; Argonne, Illinois, USA (21 Mar 1976).
Proceedings of the symposium and workshop on advanced battery research and design, March 22--24, 1976.
This paper concerns a new cell design, in which a liquid layer acts as a bipolar electrode and as a current conducting path. In a molten salt battery system, increase of current efficiency and decrease of ohmic loss are usually contradictory; but, if a liquid metal layer is used, as an intermediate current path, these factors are not in conflict any more. The principle of this method and experimental results are discussed in detail. 16 figures, 2 tables.

3160 (ANL--76-8, pp B.199-B.209) PERFORMANCE OF SHAPED GRAPHITE ELECTRODES IN SODIUM SULFUR CELLS. Minck, R.W. (Ford Motor Co., Dearborn, MI). 1976.
From Battery workshop; Argonne, Illinois, USA (21 Mar 1976).
Proceedings of the symposium and workshop on advanced battery research and design, March 22--24, 1976.
Results obtained on testing a series of cells which incorporated differently shaped graphite electrodes are presented. The results are interpreted in terms of mass transport processes. The geometry of the electrode strongly influences cell performance. Generally, geometric changes enhance discharge performance at the expense of charge performance, or vice versa. In contrast, changes in operating temperature affect both charge and discharge performance similarly. 11 figures.

3161 (ANL--76-8, pp B.231-B.238) MECHANICAL SEAL FOR THE SODIUM/SULFUR CELL. Tilley, A.R. (British Railways Board, Derby, Eng.). 1976.
From Battery workshop; Argonne, Illinois, USA (21 Mar 1976).
Proceedings of the symposium and workshop on advanced battery research and design, March 22--24, 1976.
The development of a suitable sealing method is one of the technical problems that has to be solved before the high-temperature sodium/sulfur battery becomes a commercial reality. This paper describes the development of a potentially low-cost, lightweight seal assembly that is suitable for operation at 350°C. The

results of stress analysis, seal, leak tests, and cell cycling studies are described. 3 figures, 2 tables.

3162 (ANL--76-8, pp B.277-B.292) CONSIDERATIONS IN THE USE OF ELECTRICAL MEASUREMENT TECHNIQUES TO EVALUATE POTENTIAL NEW ELECTROLYTES AND MIXED CONDUCTORS. Raistrick, I.D.; Huggins, R.A. (Stanford Univ., CA). 1976.
From Battery workshop; Argonne, Illinois, USA (21 Mar 1976).
Proceedings of the symposium and workshop on advanced battery research and design, March 22--24, 1976.
Exploratory efforts are being undertaken in a number of laboratories to identify and evaluate the properties of new solid electrolytes and mixed conductors because of their potential use in such applications as high-performance batteries and fuel cells. Due to large values of ionic mobility in such materials, particular care must be exercised either to avoid or to compensate for interfacial polarization effects. Methods for experimental determination of the important parameters in such cases are reviewed, with emphasis upon the interpretation of frequency-dependent ac measurements. 12 figures.

3163 (ANL--76-119) INSTRUMENTATION FOR AUTOMATIC CYCLING OF LITHIUM--ALUMINUM/IRON SULFIDE SECONDARY CELLS. Olsen, W.F.; Slawecki, M.A. (Argonne National Lab., Ill. (USA)). Dec 1976. Contract W-31-109-ENG-38. 15p. Dep. NTIS, PC A02;MF A01.
In the development of lithium--aluminum/iron sulfide secondary cells at Argonne National Laboratory, an instrumentation system was necessary to operate experimental cells automatically over extended periods of time. The system described in this report provides the capability for control of cell cycling and recording of data without the need for constant attendance by research personnel. In these tests electrical performance, power, energy storage capacity cyclelife and cell lifetimes are determined by repetitive charging and discharging of the cells. 5 figures.

3164 (BMFT-FB-T--76-40) RESEARCH AND DEVELOPMENT CONCERNING THE SODIUM--SULFUR BATTERY. SUBPROJECT: DEVELOPMENT OF UNCONVENTIONAL PROCESSES FOR THE PRODUCTION OF THE BETA ALUMINA SOLID ELECTROLYTE AND DEVELOPMENT OF THE SODIUM ELECTRODE. Baukal, W.; Ammende, S.; Beck, H.P.; Doebrich, H.; Klawik, R.; Knoedler, R.; Kuhn, W. (Battelle-Institut e.V., Frankfurt am Main (Germany, F.R.)). Oct 1975. 81p. (In German). Dep. NTIS (US Sales Only) $5.00.
The development of the sodium--sulfur battery was sponsored within the 'Energieforschung' program of the West German Ministry of Research and Technology. The work covers the development of unconventional processes for the production of the β alumina ceramic electrolyte and the investigation of the sodium electrode. (I) A process for the production of β alumina powder by thermal decomposition of a sprayed solution of nitrates was developed and scaled up to an extended laboratory scale. Ceramic chips made of oxide powder produced by this method had a better microstructure than ceramic parts produced by conventional methods; an economic study of the new process showed that the additional costs (in comparison to the conventional process) are acceptable. (II) It was found that the anode (molten sodium metal) can be immobilized by being sucked into a highly porous iron felt, without substantial reduction of the electrical efficiency. Consequently, a new construction concept for the battery appears to be feasible which has considerable advantages with regard to safety, weight, and corrosion. 23 figures, 11 tables.

3165 (BNL--21367) NEUTRON SCATTERING STUDIES OF SOLID ELECTROLYTES. Shapiro, S.M. (Brookhaven National Lab., Upton, N.Y. (USA)). 1976. Contract E(30-1)-16. 17p. (CONF-760552--1). Dep. NTIS $3.50.
From International conference on superionic conductors; Schenectady, New York, USA (10 May 1976).
The role which neutron scattering can play in determining the nature of the disorder and the conducting mechanism in the solid electrolytes is discussed. First, some of the general formalism for elastic and inelastic neutron scattering is reviewed, and the quantities which can be measured are pointed out. Then the application of neutron scattering to the studies of three different problems is examined; the anion disorder in the fluorite system, the dynamical behavior in beta-alumina, and the cation diffusion in αAgI are discussed. 8 figures. (RWR)

3166 (BNL--22275) NICKEL BASED ALLOYS AS ELECTROCATALYSTS FOR OXYGEN EVOLUTION FROM ALKALINE SOLUTIONS. Lu, P.W.T.; Srinivasan, S. (Brookhaven National Lab., Upton, N.Y. (USA)). Jan 1977. Contract EY-76-C-02-0016. 39p. Dep. NTIS, PC A03/MF A01.
The slowness of the oxygen evolution reaction is one of the main reasons for significant energy losses in water electrolysis cells and secondary air--metal batteries. To date, data on the kinetics of this reaction on alloys and intermetallic compounds are sparse. In this work, mechanically polished alloys of nickel with Ir, Ru or W and Ni--Ti intermetallic compounds were studied as oxygen electrodes. Since the oxygen evolution reaction always takes place on oxide-film covered surfaces, the nature of oxide films formed on these alloys were investigated using cyclic voltametric techniques. Steady-state potentiostatic and slow potentiodynamic (at 0.1 mV/s) methods were employed to obtain the electrode kinetic parameters for the oxygen evolution reaction in 30 wt. percent KOH at 80°C, the conditions normally used in water electrolysis cells. The peaks for the formation or reduction of oxygen-containing layers appearing on the pure metals are not always found on the alloys. The maximum decreases in oxygen overpotential at an apparent current density of 20 mA $cm^{-2}$ (as compared with that on Ni) were found for the alloys of 50Ni--50Ir and 75Ni--25Ru and the intermetallic compound $Ni_3Ti$, these decreases being about 40, 30, and 20 mV, respectively. On the long-term polarization in the potential region of oxygen evolution, the oxygen-containing layers on Ni--Ir or Ni--Ru alloys are essentially composed of nickel oxides instead of true mixed oxide films of two components. The present work confirms that, possibly because of coverage by oxide films, there is no direct dependence of the electrocatalytic activities of the alloys on their electronic properties. 11 figures, 1 table.

3167 (COM--75-10618) EVALUATION OF POTENTIALLY USEFUL SEPARATOR MATERIALS FOR NICKEL--CADMIUM SATELLITE BATTERIES. Baker, H.A.; Toner, S.D.; Cuthrell, W.F. (National Bureau of Standards, Washington, D.C. (USA)). 1974. 38p. NTIS.

SATELLITES;NICKEL-CADMIUM BATTERIES;BATTERY SEPARATORS;MATERIALS;PERFORMANCE TESTING

3168 (CONF-711166--, pp 502-515) NOVEL NICKEL ELECTRODE FOR ELECTRIC VEHICLES. Kugler, G.C. Nov 1971.

From 2. international electric vehicle symposium; Atlantic City, New Jersey, USA (8 Nov 1971).

International electric vehicle symposium.

A likely concept for the power source of an all-electric vehicle is a hybrid system combining a fuel cell group or a rechargeable metal--air battery with a high-power-output secondary battery. The fuel cell group or metal--air system would provide power to the vehicle primarily during normal sustained running conditions, while the high-power-output secondary battery would provide propulsive energy for high-load-demand periods during accelerations. This battery would then be recharged by the fuel cell or metal--air system during normal running. Nickel--zinc couples have been proposed as candidates for the high-power component of such hybrid systems, but have suffered from the drawback of relatively high cost due in large part to the expensive techniques required to produce sintered nickel positive plates. The characteristics of the nickel--zinc system are first briefly reviewed. Cycle life of this system is limited by the zinc negative plate, and failure usually occurs through either dendritic penetration of the separators or loss of negative capacity through ''shape change'' or active material redistribution.

3169 (CONF-711166--, pp 516-520) LAMINAR PLATE LEAD ACID BATTERIES FOR ELECTRIC VEHICLES. Duddy, J.C.; Ockerman, J.B. Nov 1971.

From 2. international electric vehicle symposium; Atlantic City, New Jersey, USA (8 Nov 1971).

International electric vehicle symposium.

The use of a new grid design in flat plate cells which have performance characteristics well matched to the requirements of pure electric vehicles is described. Many vehicles coming into use will operate at power levels equivalent to a one-hour rate discharge, and some proposed speed control systems employ very large current pulses which the battery must deliver with minimum polarization. Development of the laminar grid concept during the past five years was aimed at achieving high active material utilization and long cycle life under these conditions. Grid design and cell construction and performance are discussed. With performance levels of 10 Wh/lb and 1 Wh/in.$^3$ at the 1-hour rate, significant decreases in total battery size and weight can be achieved. Excellent charge acceptance leads to high-rate charging. 10 figures, 2 tables (RWR)

3170 (CONF-751194--, pp 131-140) CERAMICS IN ADVANCED BATTERIES. Whittingham, M.S. (Exxon Research and Engineering, Co., Linden, NJ). 1975.

From Proceedings on ceramics for energy applications; Columbus, Ohio, USA (24 Nov 1975).

Workshop proceedings on ceramics for energy applications.

The sodium/sulfur and lithium/sulfur systems, both of which operate at >300°C, are discussed. The active elements are Na/beta alumina/S and Li/LiCl--KCl molten salt/S. These two systems are used as examples to show the uses and problems that ceramics face in advanced electrochemical energy systems. Current major problems are in the area of inactive components, the seals, separators, and protective coatings. 4 figures. (RWR)

3171 (CONF-751194--, pp 204-230) CERAMICS IN LITHIUM ALLOY/METAL SULFIDE BATTERIES. Tuohig, W.D.; Battles, J.E. (Argonne National Lab., IL). 1975.

From Proceedings on ceramics for energy applications; Columbus, Ohio, USA (24 Nov 1975).

Workshop proceedings on ceramics for energy applications.

Ceramic materials are used as feedthrough insulators, electrode separators, and potentially as current-collector coatings in lithium--aluminum/metal sulfide batteries. The design and operating requirements of each component are outlined, and recent laboratory results are summarized. Present effort is directed at meeting both the technical and economic goals that have been set forth for a commercially viable battery system. 16 figures, 6 tables.

3172 (CONF-751194--, pp 231-249) CERAMICS IN THE SODIUM--SULFUR BATTERY. Gordon, R.S. (Univ. of Utah, Salt Lake City). 1975.

From Proceedings on ceramics for energy applications; Columbus, Ohio, USA (24 Nov 1975).

Workshop proceedings on ceramics for energy applications.

The requirements with respect to physical properties, processing characteristics, and in-cell performance are reviewed for the beta-type alumina electrolyte and for the current collector--container in the cathode compartment of the sodium--sulfur battery. The current status is reviewed and needs for further research and development are outlined. In addition to the sodium-ion-conducting electrolyte, ceramics may also play an important role in the development of current collectors and cathode containers for the sodium--sulfur battery. 3 tables.

3173 (CONF-760112--3) LITHIUM REQUIREMENTS FOR HIGH-ENERGY LITHIUM--ALUMINUM/IRON SULFIDE BATTERIES FOR LOAD-LEVELING AND ELECTRIC-VEHICLE APPLICATIONS. Chilenskas, A.A.; Bernstein, G.J.; Ivins, R.O. (Argonne National Lab., Ill. (USA)). 1976. Contract W-31-109-Eng-38. 19p. Dep. NTIS $3.50.

From Symposium on United States lithium resources and requirements by the year 2000; Lakewood, Colorado, USA (22 Jan 1976).

Lithium--aluminum/iron sulfide batteries are being developed at Argonne National Laboratory for use as energy storage devices on electric utilities and power sources for electric vehicles. These batteries are expected to come into commercial use around 1985 and to achieve rapid market penetration thereafter. By the end of the year 2000 as much as 3% (3 x $10^8$ kW-hr) of the projected total U. S. energy consumption could be supplied by lithium--aluminum/iron sulfide off-peak energy storage batteries. At the same time 18 million electric vehicles or more may be powered by Li--Al/iron sulfide batteries. Projections are made of the quantity of lithium required for lithium--aluminum/iron sulfide batteries produced during 1985--2000. The projected lithium requirement in the year 2000 represents a substantial fraction of the present estimate of world lithium resources, and is nearly equal to the estimated economically recoverable lithium resources in the U. S. In addition, the potential market for primary batteries using lithium will add to these requirements. Expansion of exploration

for new sources and increases in production capacity will be needed to meet the projected lithium requirements for the introduction of these batteries in sufficient quantities to produce the desired impact upon petroleum conservation goals in the U. S. transportation sector and electrical power generation. 3 figures, 3 tables. (auth)

3174 (CONF-760312--1) ELECTROCHEMICAL STUDIES OF MASS TRANSPORT IN HIGH-TEMPERATURE ELECTROLYTES. Braunstein, J.; Vallet, C.E. (Oak Ridge National Lab., Tenn. (USA)). 1975. W-7405-ENG-26 14p. Dep. NTIS $3.50.

From Battery workshop; Argonne, Illinois, USA (21 Mar 1976).

Since electrode kinetics are rapid for proposed high-temperature batteries, and since the electrolytes are frequently complex or polymeric, mass transfer polarization becomes a limiting factor in recharge rates. Transport parameters needed for design and modeling studies include interdiffusion coefficients and transference numbers. Methods such as chronopotentiometry have been applied almost exclusively to self-diffusion coefficients of dilute constituents. The chronopotentiometric method was developed to provide interdiffusion coefficients over broad ranges of concentration, and the application is illustrated in two kinds of melts: alkali fluoride--beryllium fluoride melts having a polymeric structure, and alkali chloride--aluminum chloride melts having a complex structure. 4 figures, 1 table (auth)

3175 (CONF-760503--10) LIQUID METAL ELECTRODES IN SECONDARY BATTERIES. Steunenberg, R.K. (Argonne National Lab., Ill. (USA)). 1976. Contract W-31-109-eng-38. 9p. Dep. NTIS $3.50.

From International conference on liquid metal technology in energy production; Champion, Pennsylvania, USA (3 May 1976).

Among the liquid metals that might be considered for use as electrode materials in high-performance secondary (electrically rechargeable) batteries, lithium and sodium show the greatest promise because of their low equivalent weight, electronegativity, resistivity, and polarization. Much of the early work on molten alkali metals in electrochemical cells was directed toward the development of thermally regenerative cells for the direct conversion of heat to electrical energy. The more recent work, however, has been aimed at the use of these metals in high-performance secondary batteries for electric automobiles or load leveling in electric utility systems. Most of the earlier work on cells having liquid lithium negative electrodes employed chlorine, sulfur, or other strongly electronegative materials as the positive electrode, with a molten-salt electrolyte. However, the present effort is directed mainly toward cells with solid lithium alloy (e.g., Li--Al, Li--Si) negative electrodes and metal sulfide positive electrodes. The current research and development work on sodium-electrode batteries involves a liquid sodium electrode; a solid, ion-conducting electrolyte; and a liquid sulfur or metal chloride positive electrode. Both types of systems show promise for the electric automobile and load-leveling applications. 4 tables.

3176 (CONF-770531--4) EFFECTS OF METAL ADDITIVES ON THE PERFORMANCE CHARACTERISTICS OF LITHIUM--ALUMINUM ALLOY ELECTRODES. Vissers, D.R.; Anderson, K.E.; Mrazek, F.C. (Argonne National Lab., Ill. (USA)). 1977. Contract W-31-109-ENG-38. 12p. Dep. NTIS, PC A02/MF A01.

From Meeting of the Electrochemical Society; Philadelphia, Pennsylvania, USA (8 May 1977).

Solid lithium--aluminum alloy electrodes have shown a great deal of promise for meeting the performance requirements of negative electrodes in lithium/metal sulfide batteries for stationary energy storage and for electric vehicle propulsion. In an effort to improve the performance of the lithium--aluminum alloy electrode, investigations were conducted to determine the effect of various metal additives (tin, lead, copper, and indium) on the performance and cycle life (capacity retention) of these lithium--metal alloys. The electrodes were characterized by measuring the achievable capacity densities as a function of current density and number of cycles. The addition of 5 wt percent copper, 5 wt percent tin, or 10 wt percent lead did not markedly improve the cycle life of the lithium--metal alloy electrode; however, the tin additive improved the performance of the electrode during its first 100 cycles. In contrast, the addition of indium at the 3.9 wt percent level markedly improved the cycle life. The capacity decline of the Li--Al--3.9 wt percent In alloy was less than 0.01 percent per deep cycle, which compares with about 0.06 percent per deep cycle for the binary Li--Al alloy electrode. Preliminary studies of the indium additive at the 1 wt percent level also look very promising. Postoperative photomicrographic examinations of the active material in the lithium--metal alloy electrodes suggest that the indium additive results in a more dendritic-like material than that in the binary Li--Al alloy electrodes. 1 figure, 6 tables.

3177 (CONF-770531--5) CALCIUM/IRON SULFIDE SECONDARY CELLS. Preto, S.K.; Ross, L.E.; Martin, A.E.; Roche, M.F. (Argonne National Lab., Ill. (USA)). 1977. Contract W-31-109-ENG-38. 13p. Dep. NTIS, PC A02/MF A01.

From Meeting of the Electrochemical Society; Philadelphia, Pennsylvania, USA (8 May 1977).

Studies of calcium intermetallic compounds for use as negative electrodes in molten-salt calcium/iron sulfide cells are described. The binary intermetallics of Ca with Al, Mg, and Si did not have acceptable performance characteristics, but the ternary Ca--Mg--Si intermetallic performed satisfactorily in cell tests. These calcium cells are being developed for stationary-energy-storage and electric-vehicle applications. 6 figures, 2 tables.

3178 (CONF-7610115--, pp 1-13) MAINTENANCE-FREE BATTERIES: THE LEAD--CALCIUM--TIN APPROACH. Sage, A.H. III. (St. Joe Minerals Corp., Monaca, PA). 1976.

From 39. annual convention of the Independent Battery Manufacturers Association, Inc.; Chicago, Illinois, USA (6 Oct 1976).

IBMA 39th annual convention.

The key technical points about lead-calcium-tin alloys are reviewed, and some practical considerations are related. The following topics are addressed: reasons for using lead-calcium-tin alloys; selection of the proper alloy; casting of lead-calcium-tin grids; effect of impurities on maintenance-free (MF) batteries; recycling of battery scrap; joining and assembling of cast lead-calcium-tin grids; and properties of wrought grids for MF batteries. 21 figures. (RWR)

3179 (CONF-7610115--, pp 14-18) LOW-ANTIMONY MAINTENANCE-FREE BATTERIES. Mahler,

T.F. (NL Industries, Inc., New York). 1976. From 39. annual convention of the Independent Battery Manufacturers Association, Inc.; Chicago, Illinois, USA (6 Oct 1976). IBMA 39th annual convention.

The availability of low-antimony alloys for use in the manufacture of lead-acid battery grids is discussed. The use of Cu and S as nucleating agents permits the casting of grid alloys with antimony contents lower than previously thought possible. Casting properties of low-Sb alloys are outlined. It appears that low-Sb batteries will be adequate for most applications. (RWR)

3180 (CONS/2114--3) STUDY OF THE AUXILIARIES FOR LEAD--ACID BATTERY SYSTEMS FOR PEAKING POWER. FINAL REPORT FOR THE PERIOD ENDING OCTOBER 1976. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA)). Dec 1976. Contract EX-76-C-01-2114. 274p. Dep. NTIS, PC A12/MF A01.

This volume deals with the elements of the peaking power battery system which are neither the cells nor the power converter hardware per se, but which are nonetheless required to make the system work. These include all hardware and systems required for operational control of the batteries as well as for the safety and protection of the installation and personnel. The first part of the study is concerned with the definition of the requirements for the auxiliaries, creation of a conceptual design which meets the requirements, and the performance of a cost estimate of the design. The second part delineates the effects of changes in auxiliaries design. Areas addressed are hardware sharing with the power converter gear, system reliability, impact of cooling and ventilation systems, effects of system rating on auxiliaries costs, and the effects of advances of technology in monitoring and protection devices with the use of large-capacity cells. It was found that the most economic choice for a 10-MW, 40-MWh peaking power battery system using 5-kWh cells consists of a 1620 Vdc, 10-string design. The projected cost of installation is $3,071,000, of which $1,045,000 is auxiliaries cost. The total cost per kW was found to be a steadily decreasing function of system rating; it was $325/kW at a 10 MW rating. Water cooling of the battery is the most economic choice for virtually every climate. 45 figures, 46 tables. (RWR)

3181 (COO--2520-1) LOW TEMPERATURE LITHIUM/SULFUR SECONDARY BATTERY. SEMIANNUAL PROGRESS REPORT, DECEMBER 1, 1974--JUNE 1, 1975. Brummer, S.B.; Rauh, R.D.; Marston, J.M.; Shuker, F.S. (Eic, Inc., Newton, Mass. (USA)). Jul 1975. Contract EY-76-C-02-2520. 77p. Dep. NTIS $5.00.

The objective of this program is to develop a dissolved sulfur cathode which can be repeatably charged and discharged with minimal degradation and which is compatible with a Li anode. The redox behavior of dilute $S_8$, 0.1--1M $LiClO_4$ solutions in dimethyl sulfoxide (DMSO), dimethyl formamide (DMF), tetrahydrofuran (THF), propylene carbonate (PC), γ-butyrolactone (BL), sulfolane (SL), methyl acetate (MA) and pyridine was investigated. $S_8$ and $S_8^{--}$ reductions occur at more positive potentials and the redox reactions are more reversible in DMSO and DMF than in the other solvents. Some evidence exists for the precipitation of $Li_2S$/sub x/ species on Au and Pt working electrodes (but not on C). The electrochemical behavior of $Li_2S$/sub x/ solutions was examined. Cyclic voltammograms of polysulfide solutions in DMSO showed generally reductions at more negative potentials and oxidations at more positive potentials than those for $S_8$ solutions. The polysulfide and $S_8$ voltammograms in THF were more similar. Steady-state current potential curves of DMSO--$Li_2S$/sub x/ solutions generally revealed no sizeable reduction currents positive of approximately 1.5 V vs. Li. Galvanostatic discharge of $Li_2S$/sub x/ solutions occurs between 1.0 and 2.0 V. Recharge (with a 4.0 V limit) was possible in THF, BL and DMSO. The fact that steady-state discharge in these solutions, andparticularly in DMSO--$Li_2S$/sub x/ solutions, occurs at more negative potentials than indicated by cyclic voltammograms suggests a degradation of active species in solution following initial reduction. If the species $S_3^-$ is more difficult to reduce than S--/sub x/, then solvents or electrolyte additives which stabilize S--/sub x/ in preference to $S_3^-$ would be most favorable for use in a practical battery. 23 figures, 8 tables.

3182 (COO--2564-2) BASIC RESEARCH ON CERAMIC MATERIALS FOR ENERGY STORAGE AND CONVERSION SYSTEMS. PROGRESS REPORT, DECEMBER 1, 1975--NOVEMBER 30, 1976. Whitmore, D.H. (Northwestern Univ., Evanston, Ill. (USA)). Dec 1976. Contract EY-76-S-02-2564. 35p. Dep. NTIS $4.00.

The present research program involves utilizing appropriate experimental probes for measuring the movement of ionic and electronic charge carriers in ceramic materials suitable for solid electrolyte and electrode applications in high-performance, secondary battery and fuel cell systems. Special emphasis is placed on developing: (1) a better understanding of the effects of structure, impurities and composition on charge carrier transport mechanisms in such materials; and (2) detailed knowledge of the kinetics and mechanism of reactions occurring (on a microscopic scale) at the electrode-electrolyte interfaces of energy storage and conversion systems.

3183 (EPRI--252) SUBSTRUCTURE AND PROPERTIES OF SODIUM BETA ALUMINA SOLID ELECTROLYTES. INTERIM REPORT, JUNE 1, 1974--MAY 31, 1975. De Jonghe, L.C. (Cornell Univ., Ithaca, N.Y. (USA). Dept. of Materials Science and Engineering). Jul 1975. 53p. Dep. NTIS, PC A04/MF A01.

The relation of the properties of sodium beta alumina to its microstructure and impurity content was investigated. The electrolyte was prepared from both laboratory and commercial powders; a method that significantly improves the sinterability of commercial sodium β alumina powders was developed. The ac conductivity, effects of calcium on the ionic conductivity, apparent activation energies as a function of temperature, grain boundary activation energies, and microstructure of β alumina were studied. It was found that Ca is a particularly deleterious impurity. The activation energy for inter- and transgranular ionic conduction was temperature independent. Some complex crystallographic faults were found that may be partially responsible for some frequency dependence of the complex impedance of the solid electrolyte. 17 figs., 1 table. (RWR)

3184 (EPRI--255(TR1)) NATIONAL BATTERY ENERGY STORAGE TEST (BEST) FACILITY: CONCEPTUAL DESIGN AND COST ESTIMATE. (BEST Facility Study Project Team (USA)). Aug 1975. Contract W-31-109-ENG-38. 68p. (ERDA--31-109-38-2962). Dep. NTIS, PC A04/MF A01.

Operating on the assumption that storage

batteries will be a viable technology for utility use in energy storage applications, the BEST Facility Study Project Team concluded that a battery testing facility of national scope is technically justified and economically feasible. The Project Team recommends that such a facility be built on a utility site and be in operation by 1979 to test the first load-leveling battery system. The facility design recommended embodies features to provide the flexibility required to accomodate high-temperature, aqueous, and flowing electrolyte load-leveling batteries with capacities of up to 10 MWh. A computerized data acquisition and control system is recommended to provide the capability to monitor cell voltages, cell temperatures, and other system parameters. To provide the flexibility desired for interfacing the battery systems with the utility system, a modular converter is recommended. The BEST Facility testing program will require approximately 18 months for each battery system. Major emphasis of the program will be placed on assessing battery system performance during operation in the cycling modes anticipated for use by electric utilities. The testing will also include impulse testing to extend the range of tests by use of a variable synthetic load. The estimated cost to construct and equip the facility described is $6.4 million. The design and construction schedule indicates that approximately 3 years is required from site selection to facility completion. The cost projections do not include the cost of advanced battery systems, or development of required auxiliaries. The cost to operate the BEST Facility is estimated to be $415,500 annually, in May, 1975, dollars. 5 figures, 15 table (RWR)

3185 (EPRI--255(TR2)) CONCEPTUAL DESIGN OF A BATTERY ENERGY STORAGE TEST (BEST) FACILITY. (Bechtel Corp., San Francisco, Calif. (USA)). Aug 1975. Contract W-31-109-ENG-38. 160p. (ERDA--31-109-38-2962(TR2)). Dep. NTIS, PC A08/MF A01.

Bechtel Corporation completed a conceptual design for the BEST facility. Criteria specified that the facility be implemented in phases that will accommodate the projected development of battery systems. Initially, therefore, a "Baseline" plant will be constructed and partially equipped, with additional equipment to be added later. In its fully implemented state, the BEST facility will be capable of simultaneously testing three 10-MWh battery systems. Three inverter/converter units will interface these battery systems to a utility network. A 1000 V dc bus system, comprised of three individual buses, will enable the independent connection of any battery to any one of the three inverters. Similarly, a 13.8 kV ac system will connect the inverters to either the utility network or to a synthetic load. A computer data acquisition system will be installed to facilitate handling the large amounts of data; this computer system will also be capable of control functions. Additional systems will be installed to provide for functions such as battery cooling, building heating-ventilating-air-conditioning, station auxiliary power, and safety. Initial implementation of the baseline system is expected to cost $5.88 million in May, 1975. No environmental or personnel hazards are anticipated. 21 figures, 6 tables. (RWR)

3186 (EPRI-EM--271) AC/DC POWER CONDITIONING AND CONTROL EQUIPMENT FOR ADVANCED CONVERSION AND STORAGE TECHNOLOGY. FINAL REPORT. Wood, P. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA)). Nov 1976. 109p. Electric Power Research Inst., Palo Alto, CA.

This report presents the results of the work performed since the publication of the key phase report for this project in August, 1975. This final report concludes that the two most likely long-range candidates for converting dc to ac power from batteries and fuel cells are the basic current-fed line commutated inverter (a derivative of HVDC technology), and the voltage-fed conduction angle controlled force commutated inverter. Results are presented for analyses of cost, performance, and reliability which lead to the identification of the current-fed line commutated technology as the most promising long-range choice. This conclusion is drawn for characteristics of today's solid state devices, as well as for forecast improvements in the future in those characteristics. Other conversion technologies are discussed and removed from further consideration because of their inability to satisfy cost, performance, or reliability goals. In addition, information about technology projections, control philosophy, and commutating circuits is included in this report.

3187 (EPRI-EM--413(6-77)) IMPROVEMENTS OF ELECTROLYTE AND SEAL TECHNOLOGY FOR SODIUM--SULFUR AND SODIUM ANTIMONY TRICHLORIDE LOAD LEVELING BATTERIES. FINAL REPORT. Lazennec, Y. (Compagnie Generale d'Electricite (CGE), 91 - Marcoussis (France)). Jun 1977. 132p. Dep. NTIS, PC A07/MF A01.

Possible procedures for manufacture of beta-alumina tubes using extrapolations of current practice were technically defined and costed. Powder from either molten-state or solid-state reaction, with tube-forming by either isostatic pressing or electrophoresis plus isostatic pressing were considered. Three sintering techniques using currently available furnaces were examined. Minimum selling price of optimized tubes (400 $cm^2$) will be $2.07. (II) Aluminum--alpha-alumina seals made by the proprietary thermocompression technique were fabricated and tested. Excellent leak-tightness, resistance to thermal cycling and corrosion resistance to polysulfides under static and electrochemical conditions were determined. However, some corrosion in the presence of sodium occurred due to silicon impurities in the aluminum. This should be negligible if high-purity aluminum is used. (III) Performance of the sulfur electrode was computer-simulated by an iterative method based on experimental data for thin electrodes. This work allowed optimized tube and electrode dimensions to be determined. The optimized tube was close to that determined as the cost optimum in Task I. Cells, modules, and units for a 100-Mwh load-leveling battery were designed and costed, on the basis of a production of 25 units/year. Particular attention was paid to reliability and safety, including automatic disconnection of failed cells, and together with heat transfer and recovery. Overall efficiency will be a minimum of 74.4%. Overall installed cost will be $29.6/Kwh (modules, 10 year depreciation) plus $11.4/Kwh (site and auxiliaries, 25 year depreciation. (IV) 23 electrolyte tubes were fabricated and delivered to EPRI in December 1976.

3188 (EPRI-EM--494) SUBSTRUCTURE AND PROPERTIES OF SODIUM BETA-ALUMINA SOLID ELECTROLYTES. INTERIM REPORT, JUNE 1, 1975--MAY 31, 1976. De Jonhe, L.C. (Cornell Univ., Ithaca, N.Y. (USA)). Jul 1977. 90p. Dep. NTIS, PC A05/MF A01.

The relation between microstructural imperfections, impurities, and properties of sodium β-alumina solid electrolytes was investigated. Microstructural imperfections were studied by means of transmission and scanning electron microscopy, as well as by optical microscopy. Their relation to problems in ionic conductivity, such as inhomogeneous current distributions, is discussed. Impurity effects were studied on a pre-reacted, commercially available β-alumina powder. These studies thus relate to problems that result from contamination during the electrolyte preparation. The investigations focused on the detailed examination of ionic conductivities by means of a dispersive method. The work led to the conclusions that significant, and possibly deleterious, ion current inhomogeneities can result from microstructural imperfections; that Ca is a more deleterious impurity than Si, but that the magnitude and the nature of the effect depend significantly on the sintering heat treatment; and that Zn in low concentrations can be an effective sintering aid. 43 figures, 1 table.

3189 (GEPP--299) METHODS FOR CHEMICAL ANALYSIS OF THERMAL BATTERY COMPONENTS. Lofton, C.P.; Antepenko, R.J.; Welbon, W.W. (General Electric Co., St. Petersburg, Fla. (USA). Neutron Devices Dept.). 18 May 1977. Contract EY-76-C-04-0656. 22p. Dep. NTIS, PC A02/MF A01.

Analytical methods for the quantitative analysis of a number of components of thermal batteries have been developed and evaluated. This report describes these techniques used for quantitative analysis of the depolarizer-electrolyte-binder cathode, electrolyte and electrolyte binder material, calcium in the bimetal anode, and the pyrotechnic powder in the electrical match. These methods include classical chemical, ion specific electrode, atomic absorption, X-ray emission and colorimetric procedures. Precision of each procedure is evaluated.

3190 (GEPP--324) SURFACE ANALYSIS OF PYROTECHNIC MATERIAL. Swartz, W.E. Jr. (General Electric Co., St. Petersburg, Fla. (USA). Neutron Devices Dept.). 10 Aug 1977. Contract EY-76-C-04-0656. 36p. Dep. NTIS, PC A03/MF A01.

Data taken to characterize the surface of pyrotechnic materials used in thermal batteries are summarized. The materials studied include three unique samples of iron powder, three unique samples of calcium chromate, and one sample each of nickel oxide and potassium perchlorate. Particular emphasis was placed on characterization using X-ray photoelectron spectroscopy and Auger electron spectroscopy. 17 figures, 7 tables.

3191 (LBL--5186) ENGINEERING EVALUATION OF SOLID TRANSITION-METAL SULFIDE ELECTRODES FOR USE IN HIGH ENERGY-DENSITY BATTERIES. Marmaduke, B.A.; Donaghey, L.F. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jun 1976. Contract W-7405-ENG-48. 5p. (CONF-760906--19). Dep. NTIS $3.50.

From 11. intersociety energy conversion engineering conference; State Line, Nevada, USA (12 Sep 1976).

Solid electrode materials exhibiting anomalously high alkali ion diffusivities through layered structures were studied for application in high-energy-density, fast-discharge-rate batteries. The maximum storage capacity and maximum discharge rates were studied theoretically for a spectrum of transition metal sulfides which crystallize in the $CdI_2$ and $MoS_2$ structures. Simple criteria were established for screening potentially important solid electrode materials for battery applications. 1 figure, 4 tables.

3192 (N--68-11839) SEALING OF SILVER OXIDE--ZINC STORAGE CELLS. QUARTERLY REPORT, JUNE 23--SEPTEMBER 23, 1967. (Douglas Aircraft Co., Inc., Newport Beach, Calif. (USA). Missile and Space Systems Div.). 23 Sep 1967. 34p. (NASA-CR--90523; DAC--59860-Q1). NTIS $3.00.

Miniature hybrid fuel cells for pressure control. SILVER-ZINC BATTERIES;SEALS;HYDROGEN FUEL CELLS;PRESSURE CONTROL;TESTING

3193 (N--68-16346) SEALING OF SILVER OXIDE--ZINC STORAGE CELLS. QUARTERLY REPORT, 23 SEPTEMBER--23 DECEMBER 1967. (Douglas Aircraft Co., Inc., Newport Beach, Calif. (USA). Astropower Lab.). 23 Dec 1967. 33p. (NASA-CR--92678; DAC--59860-Q2). NTIS $3.00.

Micro fuel cells for pressure control. SILVER-ZINC BATTERIES;PRESSURE CONTROL;HYDROGEN FUEL CELLS;SEALS;FEASIBILITY STUDIES; PERFORMANCE

3194 (N--68-23941) HIGH-ENERGY DENSITY ELECTROCHEMICAL CELLS. King, L.A.; Brown, A.D. Jr.; Frayer, F.H. (Air Force Academy, Colo. (USA)). 21 Mar 1968. 17p. NTIS.

Aluminium anodes for use in molten salt electrolytes. HIGH-TEMPERATURE FUEL CELLS; MOLTEN SALTS;ELECTROLYTES;ELECTRIC BATTERIES; ALUMINIUM;ANODES;ELECTRIC POTENTIAL; POLARIZATION;PERFORMANCE

3195 (N--68-27645) SEALING OF SILVER OXIDE--ZINC STORAGE CELLS. QUARTERLY REPORT, 23 DECEMBER 1967--23 MARCH 1968. (Douglas Aircraft Co., Inc., Newport Beach, Calif. (USA). Astropower Lab.). 23 Mar 1968. 42p. (NASA-CR--94104; DAC--59860-Q3). NTIS $3.00.

Miniature hybrid fuel cells for pressure control. SILVER-ZINC BATTERIES;HYDROGEN FUEL CELLS;PERFORMANCE TESTING;MEDIUM TEMPERATURE; SEALS;GASES;PRESSURE CONTROL

3196 (N--68-28554) ELECTROCHEMICAL CHARACTERIZATION OF NONAQUEOUS SYSTEMS FOR SECONDARY BATTERY APPLICATION. QUARTERLY REPORT, FEBRUARY--APRIL 1968. Lufkin, D.A.; Paez, O.A.; Remanick, A.H.; Shaw, M. (Whittaker Corp., San Diego, Calif. (USA). Narmco Research and Development Div.). 17 May 1968. 61p. (NASA-CR--72419). NTIS $6.00.

ELECTRODES;WIRES;TESTING;SOLUBILITY; CHLORIDES;FLUORIDES;PERCHLORATES;ELECTRIC BATTERIES;LITHIUM;MAGNESIUM;CALCIUM; ELECTROCHEMISTRY;CHEMICAL REACTIONS; ELECTROLYTES

3197 (N--69-12309) SEALING OF SILVER OXIDE--ZINC STORAGE CELLS. FINAL REPORT. (McDonnell Douglas Astronautics Co., Newport Beach, Calif. (USA). Astropower Lab.). 1967. Contract NAS5-10409. 81p. (NASA-CR--97817; DAC--59860-F). NTIS $6.00.

Use of miniature fuel cells to control pressure in sealed silver oxide--zinc batteries. SILVER-ZINC BATTERIES;SEALS;PRESSURE CONTROL;FUEL CELLS;GASES;DESIGN;FABRICATION; TESTING

3198 (N--69-19806) APPROACH TO OPTIMUM LOADING OF A SOLAR ARRAY WHICH EXPERIENCES TEMPERATURE CHANGES. Sussman, M. (National

Aeronautics and Space Administration, Langley Station, Va. (USA). Langley Research Center). Mar 1968. 86p. (NASA-TM-X--61520). NTIS.
Taper-current battery charge system. SOLAR CELL ARRAYS;TEMPERATURE DEPENDENCE;ELECTRIC BATTERIES;VOLTAGE REGULATORS

3199 (N--69-29708) GASEOUS ELECTROLYTES FOR BATTERIES AND FUEL CELLS. FINAL REPORT, 21 AUGUST 1964--31 JULY 1967. Naiditch, S. (Unified Science Associates, Inc., Pasadena, Calif. (USA)). Jul 1967. Contract NAS7-326. 94p. (NASA-CR--101642). NTIS $6.00.
FUEL CELLS;ELECTROLYTES;GASES;AMMONIA; ELECTROCHEMISTRY;CHEMICAL REACTIONS;SILVER NITRATES;CESIUM;ELECTROPLATING;ELECTRIC BATTERIES;RESEARCH PROGRAMS

3200 (N--69-36048) HEAT STERILIZABLE IMPACT RESISTANT CELL DEVELOPMENT. QUARTERLY REPORT, 1 JANUARY--31 MARCH 1969. Chreitzberg, A.M.; Nordblom, G.F. (Jet Propulsion Lab., Pasadena, Calif. (USA)). 25 Jul 1969. Contract NAS7-100. 63p. (NASA-CR--105512). NTIS $6.00.
EPOXIDES;STERILIZATION;PACKAGING;CONTAINERS; HEAT TREATMENTS;LEAKS;SPACECRAFT POWER SUPPLIES; ELECTRIC BATTERIES;PERFORMANCE

3201 (N--69-38423) DEVELOPMENT OF UNIFORM AND PREDICTABLE BATTERY MATERIALS FOR NICKEL--CADMIUM AEROSPACE CELLS. QUARTERLY REPORT, 8 NOVEMBER 1968--7 FEBRUARY 1969. (Tyco Labs., Inc., Waltham, Mass. (USA)). 7 Feb 1969. 74p. (NASA-CR--106013). NTIS, PC A07/MF A01.
Sintering of carbonyl nickel powder. NICKEL COMPOUNDS;CARBONYLS;SINTERING;POWDERS;PLATES; NICKEL-CADMIUM BATTERIES;INDIUM COMPOUNDS; MECHANICAL PROPERTIES;PERFORMANCE;FORECASTING; POROSITY;AIRCRAFT;SPACE VEHICLES;MATERIALS

3202 (N--69-39395) DEVELOPMENT OF UNIFORM AND PREDICTABLE BATTERY MATERIALS FOR NICKEL--CADMIUM AEROSPACE CELLS. QUARTERLY REPORT, 8 MAY--7 AUGUST 1968. (Tyco Labs., Inc., Waltham, Mass. (USA)). 7 Aug 1968. 46p. (NASA-CR--106228). NTIS, PC A07/MF A01.
Literature survey pertaining to plate manufacture. NICKEL-CADMIUM BATTERIES;PLATES; PRODUCTION;QUALITY CONTROL;PHYSICAL PROPERTIES; AIRCRAFT;SPACE VEHICLES

3203 (N--69-40063) DEVELOPMENT OF IMPROVED ZINC ELECTRODES FOR SECONDARY BATTERIES. FINAL REPORT, JULY 1968--JULY 1969. Himy, A. (McDonnell Douglas Astronautics Co., Newport Beach, Calif. (USA). Astropower Lab.). Jul 1969. 206p. (NASA-CR--72593). NTIS $6.00.
ELECTRIC BATTERIES;ELECTRODES;ZINC OXIDES; LEAD OXIDES;ZIRCONIUM OXIDES;SINTERING;SILVER-ZINC BATTERIES;NICKEL-ZINC BATTERIES;ZINC-MANGANESE BATTERIES;ZINC-AIR BATTERIES;ZINC-CHLORINE BATTERIES

3204 (N--69-40742) HEAT STERILIZABLE AND IMPACT REISTANT NI--CD BATTERY DEVELOPMENT. QUARTERLY REPORT, 1 APRIL--30 JUNE 1969. Crawford, R.L.; Bondusky, J.M.; Popat, P.V.; Rubin, E.J. (Jet Propulsion Lab., Pasadena, Calif. (USA); Texas Instruments, Inc., Attleboro, Mass. (USA)). 30 Jun 1969. 104p. (NASA-CR--106364). NTIS, PC A07/MF A01.
Electrochemistry. NICKEL-CADMIUM BATTERIES; ELECTRODES;ELECTROCHEMISTRY;ELECTRIC POTENTIAL; CATHODES;SEALS;STERILIZATION;TEMPERATURE EFFECTS

3205 (N--69-40923) DEVELOPMENT OF UNIFORM AND PREDICTABLE BATTERY MATERIALS FOR NICKEL--CADMIUM AEROSPACE CELLS. QUARTERLY REPORT, 8 FEBRUARY--7 MAY 1969. (Tyco Labs., Inc., Waltham, Mass. (USA)). 7 May 1969. 27p. (NASA-CR--106451). NTIS, PC A07/MF A01.
Plaque preparation. NICKEL-CADMIUM BATTERIES; PLATES;CHEMICAL PREPARATION;NICKEL;POWDERS; SLURRIES;COATINGS;FABRICATION;SPACE VEHICLES; AIRCRAFT;CELLULOSE;ETHERS

3206 (N--70-10779) STUDIES IN FUNDAMENTAL CHEMISTRY OF FUEL CELL REACTIONS. QUARTERLY REPORT, 1 APRIL--30 JUNE 1969. Bockris, J.O. (Pennsylvania Univ., Philadelphia (USA). Electrochemistry Lab.). 30 Jun 1969. Contract NGR-39-010-002. 51p. (NASA-CR--106638; QR--2). NTIS $6.00.
Dendritic deposition of zinc from alkaline solution. ELECTRIC BATTERIES;NICKEL-ZINC BATTERIES;SILVER-ZINC BATTERIES;ZINC-MANGANESE BATTERIES;ANODES;DENDRITES;ZINC;DEPOSITION; HYDROXIDES;SOLUTIONS;IONS;ADSORPTION;SOLIDS; ELECTRODES

3207 (N--70-16379) STUDIES IN FUNDAMENTAL CHEMISTRY OF FUEL CELL REACTIONS. QUARTERLY REPORT, 1 APRIL--30 JUNE 1969. Bockris, J.O.; Bockris, J.OM. (Pennsylvania Univ., Philadelphia (USA). Electrochemistry Lab.). 30 Jun 1969. Contract NGR-39-010-002. 51p. (NASA-CR--107590; QR--2). NTIS $6.00.
Dendritic deposition of zinc from alkaline solution. CHEMICAL REACTIONS;ELECTRIC BATTERIES; SILVER-ZINC BATTERIES;NICKEL-ZINC BATTERIES; ZINC-MANGANESE BATTERIES;ANODES;HYDROXIDES; DENDRITES;ZINC;DEPOSITION;LEAD;IONS;ADSORPTION; SOLIDS;ELECTRODES

3208 (N--70-17675) PRODUCTION OF UNIFORM NICKEL--CADMIUM BATTERY PLATE MATERIALS. QUARTERLY REPORT, 13 JUNE--12 SEPTEMBER 1969. (Gulton Industries, Inc., Metuchen, N.J. (USA)). 12 Sep 1969. 21p. (NASA-CR--107902). NTIS, PC A07/MF A01.
Effects of material and process variables on properties of sintered nickel plaque. PRODUCTION;NICKEL-CADMIUM BATTERIES;PLATES; SINTERED MATERIALS;TIME DEPENDENCE;TEMPERATURE EFFECTS;VISCOSITY;CONTROLLED ATMOSPHERES; SUBSTRATES;CADMIUM COMPOUNDS;NICKEL;ELECTRIC CONDUCTIVITY;POROSITY;POWDERS

3209 (N--70-25705) STUDIES IN FUNDAMENTAL CHEMISTRY OF FUEL CELL REACTIONS. QUARTERLY REPORT, 1 JULY--30 SEPTEMBER 1969. Bockris, J.O. (Pennsylvania Univ., Philadelphia (USA). Electrochemistry Lab.). 30 Sep 1969. Contract NGR--39-010-002. 52p. (NASA-CR--109481; QR--3). NTIS $3.00.
Dendritic deposition of zinc from alkaline solution. HYDROXIDES;ELECTRIC BATTERIES;NICKEL-ZINC BATTERIES;SILVER-ZINC BATTERIES;ZINC-MANGANESE BATTERIES;ANODES;DENDRITES;ZINC; INHIBITION;RHODIZONIC ACID;REDUCTION;ELECTRODES; IONS;ADSORPTION

3210 (N--70-28473) DEVELOPMENT OF UNIFORM AND PREDICTABLE BATTERY MATERIALS FOR NICKEL--CADMIUM AEROSPACE CELLS. INTERIM ANNUAL REPORT, 8 AUGUST 1968--7 JULY 1969. (Tyco Labs., Inc., Waltham, Mass. (USA)). Jul 1969. 55p. (NASA-CR--110078). NTIS, PC A02/MF A01.
Preparation of porous nickel plaques. NICKEL-CADMIUM BATTERIES;PLATES;CATHODES;SPACECRAFT POWER SUPPLIES;POWDER METALLURGY;SPACE VEHICLES; AIRCRAFT;FABRICATION

3211 (N--70--32647) INVESTIGATION OF ELECTRODE MATERIALS FOR ALKALINE BATTERIES. QUARTERLY REPORT. Arcand, G.M. (Idaho State Univ., Pocatello (USA); Jet Propulsion Lab., Pasadena, Calif. (USA); California Inst. of Tech., Pasadena (USA). Dept. of Chemistry). 25 Nov 1969. 25p. (NASA-CR--110756). NTIS $3.00.
The diffusion coefficient for the silver species in 9.94 VF KOH was found to be 2.75 +- 0.000007 $cm^2/s$ at 25 +-0.1C. Argentic oxide was found to decompose slowly at temperatures at least as low as 86C and possibly lower. Both AgO and $Ag_2O$ can be activated to take up a substance or substances from the atmosphere at room temperature. Activation temperatures at least as low as 66 C are effective. No adsorption occurs without prior heating. Amalgam electrodes in propylene carbonate and in dimethyl formamide do not show good high-rate discharge characteristics. Lithium amalgams in $LiClO_4$ produced open-circuit voltages around -2.1 V vs the Hg/Hg electrode.

3212 (N--70-35576) DEVELOPMENT OF UNIFORM AND PREDICTABLE BATTERY MATERIALS FOR NICKEL--CADMIUM AEROSPACE CELLS. QUARTERLY REPORT, 8 SEPTEMBER--7 DECEMBER 1969. (Tyco Labs., Inc., Waltham, Mass. (USA)). 7 Dec 1969. 64p. (NASA-CR--110025). NTIS, PC A02/MF A01.
MATERIALS;NICKEL-CADMIUM BATTERIES;CHEMICAL COMPOSITION;SOLUTIONS;PH VALUE;TEMPERATURE DEPENDENCE;ELECTRIC CURRENTS;ELECTROCHEMISTRY; CATHODES;IMPREGNATION;SPACE VEHICLES;AIRCRAFT

3213 (N--71-28053) PRODUCTION OF UNIFORM NICKEL--CADMIUM BATTERY PLATE MATERIALS. QUARTERLY REPORT, 13 SEPTEMBER--12 DECEMBER 1969. (Gulton Industries, Inc., Metuchen, N.J. (USA)). Dec 1969. 43p. (NASA-CR--119000). NTIS, PC A03/MF A01.
Effect of material and process variables on plaque and plate characteristics. NICKEL-CADMIUM BATTERIES;PLATES;CATHODES;SINTERED MATERIALS;IMPREGNATION;PRODUCTION;MATERIALS; PRODUCTION

3214 (N--73-25104) CALCULATION AND COST OPTIMIZATION OF CERTAIN SOLAR GENERATOR THERMOBATTERY PARAMETERS. Drabkin, L.M. (Army Foreign Science and Technology Center, Charlottesville, VA). 12 Jan 1973. 12p. (AD--759812; FSTC-HT--23-1433-72). NTIS.
Translated from Geliotekhnika; No. 1, 9-15(1971).
SOLAR RADIATION;THERMOELECTRIC GENERATORS; ECONOMICS;ELECTRIC BATTERIES;COST;SOLAR ENERGY CONVERSION

3215 (N--74-15744) PROCEDURE FOR ANALYSIS OF NICKEL-CADMIUM CELL MATERIALS. Halpert, G.; Ogunyankin, O.; Jones, C. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center). Oct 1973. 46p. (NASA-TM-X--70575; X--761-73-314). NTIS $4.50.
NICKEL-CADMIUM BATTERIES;QUALITY CONTROL; ELECTROLYTES;BATTERY SEPARATORS;INSPECTION; SAMPLING

3216 (N--74-16808) STUDY OF DEGRADATION OF PLATES FOR NICKEL--CADMIUM SPACECRAFT CELLS. INTERIM REPORT. Scott, W.R. (TRW Systems Group, Redondo Beach, Calif. (USA)). Nov 1973. Contracts NAS7-100; JPL-953649. 55p. (NASA-CR--136863; TRW--24118-6001-RU-00). NTIS $5.75.
NICKEL-CADMIUM BATTERIES;SPACE VEHICLES; NICKEL OXIDES;DECOMPOSITION

3217 (N--74-19713) RESEARCH ON ELECTRODES AND ELECTROLYTE FOR THE FORD SODIUM--SULFUR BATTERY. QUARTERLY REPORT, 30 JUN--30 SEP 1973. (Ford Motor Co., Dearborn, Mich. (USA)). Oct 1973. 66p. (PB--225720). NTIS $5.50.
SODIUM-SULFUR BATTERIES;ELECTRODES; ELECTROLYTES;TESTING;FABRICATION

3218 (N--74-20707) PENETRATION OF CADMIUM INTO NYLON SEPARATORS OF NI--CD BATTERIES. Mayer, S.W.; Taylor, D. (Aerospace Corp., El Segundo, Calif. (USA)). 2 Jan 1974. Contract F04701-73-C-0074. 23p. (AD--774562; TR--0074(4270-10)-3; SAMSO-TR--74-17). NTIS.
NICKEL-CADMIUM BATTERIES;BATTERY SEPARATORS; SATELLITES;IMPURITIES;NYLON;CADMIUM;MIGRATION LENGTH

3219 (N--74-26498) STUDY, SELECTION, AND PREPARATION OF SOLID CATIONIC CONDUCTORS. FINAL REPORT, 13 NOVEMBER 1972--12 NOVEMBER 1973. Roth, W.L.; Muller, O. (General Electric Co., Schenectady, N.Y. (USA)). Apr 1974. Contract NAS3-17339. 69p. (NASA-CR--134610; SRD--74-034). NTIS $6.50.
ELECTRIC BATTERIES;ELECTROLYTES;SOLIDS; MEDIUM TEMPERATURE;ELECTRIC CONDUCTIVITY; CRYSTAL STRUCTURE

3220 (N--74-26511) FABRICATION AND TEST OF INORGANIC/ORGANIC SEPARATORS. FINAL REPORT, NOV 1972-JAN 1974. Smatko, J.S. (Stanford Research Inst., Menlo Park, Calif. (USA)). Feb 1974. Contract NAS3-17344. 73p. (NASA-CR--134646; SRI-PYU--2285). NTIS $6.75.
SILVER-ZINC BATTERIES;BATTERY SEPARATORS; FABRICATION;PERFORMANCE TESTING

3221 (N--74-30505) REVERSIBLE ELECTRODE REACTIONS OF DIFFICULT-TO-DISSOLVE MATERIALS IN NONAQUEOUS ELECTROLYTES (A CONTRIBUTION TO THE KNOWLEDGE ON POTENTIAL CATHODES FOR SECONDARY HIGH-ENERGY-DENSITY BATTERIES WITH SPECIAL CONSIDERATION OF GRAPHITE COMPOUNDS. Bensenhard, J.O. (Technische Univ. Muenchen (Germany, F.R.)). 17 May 1973. 193p. (In German). NTIS.
Thesis.
Reversible electrochemical reactions of copper, silver, mercury, and titanium electrodes in solutions of lithium bromide or lithium iodide in propylene carbonate were studied by the potentiometric triangular voltage method. Results showed that copper and silver halogens dissolved in excessive LiX in a complex manner, and that this tendency was minimized for Hg and Pb and not at all pronounced for Ti. Oxidation of electronically conductive active graphite was reversible in numerous nonaqueous solutions. A graphite anodic reaction was proven in organic electrolytic solutions of MX/PC (MX = $LiClO_4$, $NaBF_4$, $KPF_6$) by the oxidation of stoichiometric graphite compounds C/sub n/X with n greater than or equal to 24.

3222 (N--74-34539) LONG LIFE, RECHARGEABLE NICKEL--ZINC BATTERY. FINAL REPORT. Luksha, E. (Gould, Inc., Mendota Heights, Minn. (USA)). Sep 1974. Contract NAS3-16809. 90p. (NASA-CR--134658). NTIS $7.50.
NICKEL-ZINC BATTERIES;BATTERY SEPARATORS; INORGANIC COMPOUNDS;PERFORMANCE TESTING;

LIFETIME

3223 (N--75-15164) STUDY OF DEGRADATION OF PLATES FOR NICKEL--CADMIUM SPACECRAFT CELLS. FINAL REPORT. Scott, W.R. (TRW Systems Group, Redondo Beach, Calif. (USA)). Jun 1974. Contract NAS7-100. 151p. (NASA-CR--141357; TRW--24118-6002-RU-00). NTIS $6.25.
For Jet Propulsion Lab., Pasadena, CA.
Relative merits of coining sintered plates.
NICKEL-CADMIUM BATTERIES;PLATES;PERFORMANCE; DECOMPOSITION;SINTERED MATERIALS;PERFORMANCE TESTING;FABRICATION;NICKEL OXIDES;CADMIUM;SPACE VEHICLES

3224 (N--75-17807) FACTORS INFLUENCE FLEXIBILITY, RESISTIVITY, AND ZINC DENDRITE PENETRATION RATE OF INORGANIC SEPARATORS FOR ALKALINE BATTERIES. Sheibley, D.W. (National Aeronautics and Space Administration, Cleveland, Ohio (USA). Lewis Research Center). Mar 1975. 20p. (NASA-TM-X--3199; E--8054). NTIS $3.25.
SILVER-ZINC BATTERIES;NICKEL-ZINC BATTERIES; BATTERY SEPARATORS;ELECTRIC CONDUCTIVITY; FILLERS;ADDITIVES;ORGANIC COMPOUNDS;FLEXIBILITY

3225 (N--75-18717) SINTER OF UNIFORM, PREDICTABLE, BLEMISH-FREE NICKEL PLAQUE FOR LARGE AEROSPACE NICKEL CADMIUM CELLS. Seiger, H.N. (Heliotek, Sylmar, Calif. (USA)). Feb 1975. Contract NAS1-10694. 75p. (NASA-CR--132481). NTIS $4.25.
Grid fabrication. NICKEL-CADMIUM BATTERIES; NICKEL;SLURRIES;CHEMICAL COMPOSITION;BINDERS; MIXING;SINTERING;GRIDS;FABRICATION;SPACE VEHICLES;AIRCRAFT

3226 (N--75-24504) RESEARCH FOR PREPARATION OF CATION-CONDUCTING SOLIDS BY HIGH-PRESSURE SYNTHESIS AND OTHER METHODS. FINAL REPORT, 1 AUG 1973--28 FEB 1975. Goodenough, J.B.; Hong, H.Y.P.; Kafalas, J.A.; Dwight, K. Jr. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). 31 Mar 1975. 30p. (NASA-CR--134836). NTIS $3.75.
It was shown that two body-centered-cubic skeleton structures, the Im3 $KSbO_3$ phase and the defect-pyrochlore phase A(/sup+/)B2X6, do exhibit fast Na(/sup +/)-ion transport. The activation energies are higher than those found in beta-alumina. There are two possible explanations for the higher activation energy: breathing of the bottleneck (site face or edge) through which the A(/sup +/) ions must pass on jumping from one site to another may be easier in a layer structure and/or A(/sup +)--O bonding may be stronger in the cubic structures because the O($^{2}$/sup -/) ion bonds with two (instead of three) cations of the skeleton. If the former explanation is dominant, a lower activation energy may be achieved by optimizing the lattice parameter. If the latter is dominant, a new structural principle may have to be explored.

3227 (N--75-29452) EVALUATION OF NI--CD CELL COVERS. RESULTS OF TESTING OF COVERS WITH PROTECTED BRAZING FILLET. Vandervet, W.J. (Nationaal Lucht- en Ruimtevaartlaboratorium, Amsterdam (Netherlands)). Jan 1975. 56p. (NLR-TR--75033-C; ESRO-CR(P)--656). NTIS $4.25.
Three types of covers were tested by potentio-dynamic scanning to assess whether nickel plating or nickel plating and molded Araldite potting gives sufficient protection against the electro-corrosive attack of brazing fillets. The unprotected covers failed after a short testing period by a partial short circuit between the lead-through and the cover. The protected covers did not fail during the testing period. It is concluded that nickel plating provides better protection than nickel plating combined with potting.

3228 (N--75-30512) BATTERY PEAK CHARGE VOLTAGE MONITOR FOR DUAL AIR DENSITY SATELLITE. Shull, T.A. (National Aeronautics and Space Administration, Langley Station, Va. (USA). Langley Research Center). 23 Jul 1975. 10p. (NASA-TM-X--72669). NTIS $3.25.
A battery peak charge voltage monitor was developed for use on the dual air density satellite (DADS). This device retains a reading of the maximum voltage reached by the spacecraft battery during periods of charging, and makes it available during periods of data transmission. The monitor is connected across the battery and operates solely from the battery; it is powered continuously with quiescent input current of only 3 milliamperes. Standard integrated circuits and a thin-film resistor network are utilized. The monitor occupies approximately 40 square centimeters of a printed-circuit board within a larger electronic package. (auth)

3229 (N--75-32597) AN EVALUATION OF POTENTIALLY USEFUL SEPARATOR MATERIALS FOR NICKEL--CADMIUM (NI--CD) SATELLITE BATTERIES. FINAL REPORT. Baker, H.A.; Toner, S.D.; Cuthrell, W.F. (National Bureau of Standards, Washington, D.C. (USA)). Oct 1974. 38p. (NASA-CR--143504; COM--75-10618/7). NTIS $4.00.
Sponsored in Part by NASA.
An evaluation intended to determine the potential suitability and probable efficacy of a group of separator materials for use in nickel--cadmium (Ni--Cd) satellite batteries was carried out. These results were obtained using test procedures established in an earlier evaluation of other separator materials, some of which were used in experimental battery cells subjected to simulated use conditions. The properties that appear to be most important are high electrolyte absorptivity, good electrolyte retention, low specific resistivity, rapid wettability and low resistance to air permeation. Wicking characteristics and wet-out time seem to be more important with respect to the initial filling of the battery with the electrolyte. (GRA)

3230 (N--75-33497) ELECTROLYTE CONCENTRATION CHANGES DURING OPERATION OF THE NICKEL--CADMIUM CELL. Halpert, G. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center). May 1975. 13p. (NASA-TM-X--70977; X--711-75-135). NTIS $3.50.
Submitted for Publication.
The concentration and distribution of aqueous potassium hydroxide (KOH) electrolyte in a sealed nickel--cadmium cell is considered. The reactions at both electrodes during charge and discharge involve the production or utilization of hydroxyl ion (OH) or water ($H_2O$), which directly affects concentration. Changes in electrolyte concentration relative to the individual electrode reactions is discussed. Quantitative values are provided for the changes in concentration for 6-, 12-, and 20-Ah cells with accepted quantities of precharge and accepted initial quantity of 31% aqueous KOH. Consideration is given to a more accurate equation which includes net changes in hydroxyl concentration in addition to water.

Also, expected concentrations of electrolyte in cells in the fully charged, 75% charged, 50% charged, 25% charged, and discharged conditions are calculated. The expected concentration changes for cells in the accelerated tests are also tabulated and compared with measured values. All calculations are made on the assumption that there are no side reactions. Various properties which depend on KOH concentration are listed. The variables include $O_2$, $H_2$, and $Cd(OH)_2$ solubilities in addition to viscosity and conductivity. (auth)

3231 (N--76-17645) FUNCTIONING OF INORGANIC/ORGANIC BATTERY SEPARATORS IN SILVER--ZINC CELLS. Philipp, W.H.; May, C.E. (National Aeronautics and Space Administration, Cleveland, Ohio (USA). Lewis Research Center). Feb 1976. 21p. (NASA-TM-X--3357; E--8216). NTIS $3.50.

The results of three experimental studies related to the inorganic/organic battery separator operating mechanism are described: saponification of the plasticizer, resistivity of the simulated separators, and zincate diffusion through the separators. The inorganic/organic separator appears to be a particular example of a general class of ionic conducting films composed of inorganic fillers and/or substrates bonded together by an organic polymer containing an incompatible plasticizer that may be leached by the electrolyte. The I/O separator functions as a microporous film of varying tortuosity with essentially no specific chemical inhibition to zincate diffusion. (auth)

3232 (N--76-18352) TIME DELAY CUT-OUT FOR BATTERY-OPERATED EQUIPMENT. Wylie, R. (Australian Post Office Research Labs., Melbourne). Feb 1973. 16p. (REPT--6738). NTIS $3.50.

The time delay cut-out which solves the battery life problems of some battery operated instruments is described. Drawing a very small current of its own (less than 2μA), it causes no further load on the batteries. However, there is a serious voltage drop associated with the switching device, and certain supply configuration limitations presently limit the application of the cut-out. (auth)

3233 (N--76-27667) INVESTIGATION OF METAL HYDRIDE MATERIALS AS HYDROGEN RESERVOIRS FOR METAL--HYDROGEN BATTERIES. Onischa. (Energy Research Corp., Danbury, Conn. (USA) ). 30 Jun 1976. Contract NAS3-18557. 50p. (NASA-CR--135031). NTIS $4.00.

The performance and suitability of various metal hydride materials were examined for use as possible hydrogen storage reservoirs for secondary metal--hydrogen batteries. Lanthanum pentanickel hydride appears as a probable candidate in terms of stable hydrogen supply under feasible thermal conditions. A kinetic model describing the decomposition rate data of the hydride has been developed. (auth)

3234 (N--76-27697) HERMETIC COVERS FOR EUROPEAN NI/CD CELLS. Montalenti, P. (European Space Research and Technology Centre, Noordwijk (Netherlands)). Jan 1976. 35p. NTIS, PC A03/MF A01.

Various designs and technologies used in covers of European Ni/Cd battery cells are reviewed. Failure modes and test procedures for the assessment of failure modes are evaluated as the first part of a qualification program for the covers of Ni/Cd cells to be used in future European satellites. Electrochemical corrosion as failure mode, potentio-dynamic scanning as test criterion, and nickel plating as protection technique are highlighted. (auth)

3235 (N--76-28648) LIFE CAPABILITY OF THE SILVER ELECTRODE IN ALKALINE ELECTROCHEMICAL CELLS. Frank, H.A. (Jet Propulsion Lab., Pasadena, Calif. (USA)). 1 Aug 1976. Contract NAS7-100. 38p. (NASA-CR--148485; JPL-TM--33-789). NTIS, PC A03/MF A01.

Estimates of silver electrode degradation rates were made by comparing the recently measured capacities with the reported early life capacities. Chemical analyses were carried out to determine the extent of silver loss from the electrode and its distribution throughout the cell components. The results established that the silver electrode is very stable when stored at reduced temperatures in the range of 0 to -51 C, in which it exhibits a permanent degradation in capacity of 0.5%/year. The results also indicated that the silver electrode is not quite as stable when operated and stored at room temperature, where it exhibits permanent degradation in the range of 3% to 14%/year. These results were employed in predicting the life capability of the proposed new Ag--$H_2$ cell and also in assessing the merits of employing silver electrodes in long-life probe batteries.

3236 (N--76-32651) DEVELOPMENT OF SINGLE-CELL PROTECTORS FOR SEALED SILVER--ZINC CELLS. PHASE 1. FINAL REPORT, APR 1975--APR 1976. Imamura, M.S.; Donovan, R.L.; Lear, J.W.; Murray, B. (Martin Marietta Aerospace, Denver, Colo. (USA)). Sep 1976. Contract NAS3-19432. 128p. (NASA-CR--135054; MCR--76-263). NTIS (US Sales Only).

A single cell protector (SCP) assembly capable of protecting a single silver--zinc (AG/Zn) battery cell was designed, fabricated, and tested. The SCP provides cell-level protection against overcharge and overdischarge by a bypass circuit. The bypass circuit consists of a magnetic-latching relay that is controlled by the high- and low-voltage limit comparators. Although designed specifically for secondary Ag--Zn cells, the SCP is flexible enough to be adapted to other rechargeable cells. Eighteen SCP's were used in life testing of an 18-cell battery. The cells were sealed Ag--Zn system with inorganic separators. For comparison, another 18-cell battery was subjected to identical life test conditions, but with battery-level protection rather than cell-level. An alternative approach to the SCP design in the form of a microprocessor-based system was conceptually designed. The comparison of SCP and microprocessor approaches is also presented and a preferred approach for Ag--Zn battery protection is discussed.

3237 (N--77-10639) EVALUATION OF INORGANIC/ORGANIC SEPARATORS. FINAL REPORT. Donnel, C.P.I. (Yardney Electric Corp., Pawcatuck, Conn. (USA). Electric Div.). Oct 1976. Contract NAS3-18530. 20p. (NASA-CR--135108). NTIS, PC A02/MF A01.

Thirty-six (36) experimental 40AH sealed silver-zinc cells were constructed during phase I of this two (2) phase program. These cells were divided into six (6) groups of six (6) cells each. Each group of six (6) cells was evenly divided into two batches of three (3) cells each. Groups 1 through 4 each featured a different inorganic filler material in the slurry used to coat the separator substrate. Groups 5 and 6 featured an alternate method of separator bag construction. With the exception of the various separator materials, the parts

and processes used to produce these thirty-six (36) cells were the same as those used to make the HR40-7 cell. The two (2) batches of cells in each cell group differed only in the lots of solutions and other separator slurry components used. Each cell was given two formation charge/discharge cycles prior to being shipped to NASA Lewis Research Center. Phase II of the program consisted of constructing another thirty-six (36) 40AH experimental cells in six (6) groups of six (6) cells each. Each group was distinguished by the type of precoated separator material used to fabricate separator bags. A new method of separator bag construction was used in this phase of the program. These cells were given two (2) formation cycles and shipped to NASA Lewis Research Center.

3238 (N--77-12511) METHOD AND APPARATUS FOR RECONDITIONING NICKEL--CADMIUM BATTERIES. Kapustka, R.E. (National Aeronautics and Space Administration, Huntsville, Ala. (USA). George C. Marshall Space Flight Center). 24 Nov 1976. 13p. NTIS, PC A02/MF A01.

A method and apparatus for reconditioning batteries are described which can be applied in reconditioning nickel--cadmium batteries in outer space. A dc--dc converter monitors the output of each cell of a Ni--Cd battery through the use of N low voltage outputs connected in parallel to the converter. The open circuit output voltage of each of these outputs is less than the battery cell voltage. Because each output consists of two rectifier diodes, the cell voltage will normally reverse bias (turn off) the two diodes in each output. If, however, the cell voltage falls below the voltage of its corresponding output, the voltage from a transformer winding in the converter would forward bias the diodes and would assume the load. This would prevent the cell from reaching zero voltage and reversing its polarity during normal operation or reconditioning.

3239 (N--77-14585) NEW SEPARATORS FOR NICKEL--ZINC BATTERIES. Sheibley, D.W. (National Aeronautics and Space Administration, Cleveland, Ohio (USA). Lewis Research Center). Dec 1976. 20p. (NASA-TM-X--3465; E--8915). NTIS PC A02/MF A01.

Flexible separators consisting of a substrate coated with a mixture of a polymer and organic and inorganic additives were cycle tested in nickel--zinc cells. By substituting a rubber-based resin for polyphenylene oxide in the standard inorganic-organic separator, major improvements in both cell life and flexibility were made. Substituting newsprint for asbestos as the substrate shows promise for use on the zinc electrode and reduces separator cost. The importance of ample electrolyte in the cells was noted. Cycle lives and the characteristics of these flexible, low-cost separators were compared with those of a standard microporous polypropylene separator.

3240 (N--77-19572) CADMIUM ELECTRODE: REVIEW OF THE STATUS OF RESEARCH. Gross, S.; Glockling, R.J. (Boeing Co., Seattle, Wash. (USA)). Sep 1976. Contracts NAS7-100;JPL-953984. 163p. (NASA-CR--149860; D--180-19046-2). NTIS PC A08/MF A01.

Subm-Prepared for JPL..

Investigations characterizing the negative cadmium electrode used in a nickel cadmium battery cell are summarized with citations to references where more detailed information is available. Emphasis is placed on data pertinent to aerospace applications. An evaluation of some of the published results of cadmium electrode research is included.

3241 (NASA-CR--1434) ELECTROCHEMICAL CHARACTERIZATION OF NONAQUEOUS SYSTEMS FOR SECONDARY BATTERY APPLICATION. Shaw, M.; Paez, O.A.; Ludwig, F.A. (National Aeronautics and Space Administration, Washington, D.C. (USA)). 1969. vp.

1000 electrode--organic electrolyte combinations. ELECTRIC BATTERIES;ELECTRODES; ELECTROLYTES;ELECTROCHEMISTRY;SILVER;COPPER; NICKEL;COBALT;ZINC;CADMIUM;INDIUM;IRON; MOLYBDENUM;CHROMIUM;MANGANESE;REVIEWS

3242 (NASA-CR--94104) SEALING OF SILVER OXIDE--ZINC STORAGE CELLS. (Douglas Aircraft Co., Inc., Newport Beach, Calif. (USA)). 23 Mar 1968. vp. NTIS.

In the continuing evaluation of miniature hybrid fuel cells for controlling pressure, tests were conducted on 24 sealed assemblies consisting of a composite silver oxide-zinc cell and dual micro fuel cell assembly. The program included stand tests at both room temperature and 0°C. Operation was on a continuous 24-hour cycle regime and a 90-minute cycle mode. The results obtained indicate that, in low gassing rate environments such as were found on the open circuit stand or on the 24-hour cycle regime, the micro fuel cells performed their function effectively in the primary mode of operation, and in high gassing rate environments such as the 90-minute cycle mode, the micro fuel cells had to be recharged in order to satisfactorily perform their function. An improved method for charging CD micro fuel cells is proposed.

3243 (NASA-TM-X--3080) STRUCTURE AND FUNCTION OF AN INORGANIC--ORGANIC SEPARATOR FOR ELECTROCHEMICAL CELLS. Bozek, J.M. (National Aeronautics and Space Administration, Cleveland, Ohio (USA). Lewis Research Center). 1974. 14p. TIC.

BATTERY SEPARATORS;ORGANIC COMPOUNDS; INORGANIC COMPOUNDS;ASBESTOS;LAYERS;SILVER-ZINC BATTERIES;HYDROXIDES;PERFORMANCE;DESIGN; FAILURES;ELECTRON MICROSCOPY;ELECTRON SPECTROSCOPY;X-RAY SPECTROSCOPY;METALLURGY; POLYPHENYLS;CHLOROFORM;PLASTICIZERS;FILLERS

3244 (NASA-TM-X--3199) FACTORS INFLUENCING FLEXIBILITY, RESISTIVITY, ZINC DENDRITE PENETRATION RATE OF INORGANIC SEPARATORS FOR ALKALINE BATTERIES. Sheibley, D.W. (National Aeronautics and Space Administration, Cleveland, Ohio (USA). Lewis Research Center). 1975. 18p. TIC.

FLEXIBILITY;ELECTRIC CONDUCTIVITY;ZINC; DENDRITES;INORGANIC COMPOUNDS;BATTERY SEPARATORS;HYDROXIDES;ELECTRIC BATTERIES;SILVER-ZINC BATTERIES;NICKEL-ZINC BATTERIES;ZINC-MANGANESE BATTERIES;ELECTROCHEMISTRY;FILLERS; COATINGS;PLASTICIZERS;SAPONIFICATION

3245 (NASA-TN-D--8007) DETERMINATION OF HYDROXIDE AND CARBONATE CONTENTS OF ALKALINE ELECTROLYTES CONTAINING ZINC. Otterson, D.A. (National Aeronautics and Space Administration, Cleveland, Ohio (USA). Lewis Research Center). 1975. 10p.

Problems sometimes arise in the determination of $OH^-$ and $CO_3^-$ in alkaline battery electrolytes by titration with HCl, due to the presence of interfering Zn. This Zn can be masked by using a $BaCl_2$--EDTA reagent during titration to the pH 8.35 end point. Applications of this procedure are illustrated.

(RWR)

3246 (NP--21315) MEASUREMENT OF THE CONDUCTIVITY OF COPPER SULFATE SOLUTIONS. ENERGY STORAGE AND DISSIPATION NOTES: NOTE 4. Martin, J.C. (UKAEA Weapons Group, Aldermaston. Atomic Weapons Research Establishment). 22 Jul 1966. 4p. Dep. NTIS (US Sales Only) $3.50.
Sources of error in the resistivity measurements are discussed. The data are plotted as a graph of the volume of water to be added to standard (2.36 N) solution to give any required resistivity. (DLC)

3247 (NSF/RA/N--73-109) RESEARCH ON ELECTRODES AND ELECTROLYTE FOR THE FORD SODIUM--SULFUR BATTERY. QUARTERLY REPORT, JUNE 30, 1973--SEPTEMBER 30, 1973. Petrocelli, J.V. (Ford Motor Co., Dearborn, Mich. (USA)). Oct 1973. 65p. NTIS $5.50.
SODIUM-SULFUR BATTERIES;ELECTRODES; ELECTROLYTES;RESEARCH PROGRAMS;FABRICATION; CHEMICAL COMPOSITION;TESTING;SINTERING;SINTERED MATERIALS;CERAMICS;CHEMICAL REACTION KINETICS; CATHODES;CORROSION;IRON

3248 (ORO--4874-2) SEPARATORS FOR LITHIUM ALLOY--IRON SULFIDE FUSED SALT BATTERIES. FIRST ANNUAL REPORT. Walker, R.D. Jr. (Florida Univ., Gainesville (USA). Engineering and Industrial Experiment Station). 16 Mar 1976. EY-76-S-05-4874
28p. Dep. NTIS $4.00.
In an effort to overcome certain limitations of separators woven from boron nitride roving and to provide alternative separator formulations, an investigation of paper-like separators made from materials which are stable in the battery environment was undertaken. The principal areas of research to date involved materials, fiber dispersion, sheet formation and processing, and separator evaluation. Separators made from mixtures of fibers, sometimes including powders, proved to have excellent properties, provided at least small amounts of asbestos are incorporated in the mixture. Separators without asbestos proved to to be too fragile to be of serious interest; and; although the strength of these separators can be improved by the addition of inorganic binders; these introduce undesirable problems, Mixtures of asbestos with boron nitride, yttria, or lithium aluminate fibers yielded separator sheets with excellent physical and mechanical properties. A separator containing 10 wt percent asbestos and 90 wt percent yttria fibers has already run more than 500 hours in an experimental cell, and the performance is still excellent. Methods of fiber dispersion, sheet formation and processing and of separator evaluation are described, and typical results are reported. 6 tables.

3249 (PB--221475) BATTERIES USED WITH LAW ENFORCEMENT COMMUNICATIONS EQUIPMENT: CHARGERS AND CHARGING TECHNIQUES. Scott, W.W. Jr. (National Bureau of Standards, Washington, D.C. (USA)). Jun 1973. 49p. (NBS--10732). NTIS $3.75.
NICKEL-CADMIUM BATTERIES;LEAD-ACID BATTERIES; SEALS;BATTERY CHARGING;PERFORMANCE;BATTERY CHARGERS;RADIO EQUIPMENT POWER SUPPLIES; COMPARATIVE EVALUATIONS

3250 (PB--228006/3) POLLUTION-FREE ELECTROCHEMICAL POWER GENERATION FROM LOW GRADE COAL. McMillen, D.F.; Weaver, R.D.; Anbar, M. (Stanford Research Inst., Menlo Park, Calif. (USA)). Aug 1973. 50p. (NSF-RA/N--73-0108). NTIS $3.25.
The report describes the results of a study exploring the feasibility of a nonpolluting, combined chemical--electrochemical system for generating electrical power. The process entails the use of coal to reduce lead oxide to a lead in a molten carbonate medium. The lead contained in the molten carbonate is then used in a metal--air electrochemical cell to generate electrical power. To date it has been demonstrated that reduction of lead oxide by solid petroleum coke in a molten sodium--lithium--potassium carbonate eutectic is a two-step process whose overall rate is generally limited by the rate of reaction of solid carbon with $CO_2$. The rate of this latter reaction, in turn, is directly proportional to the external surface area of the coke. Under these conditions temperature dependence of the overall process provides an apparent activation energy of about 35 kcal/mole over the temperature range 530 to 650 C. Extrapolation of the results indicates that the feasibility of the concept will not be limited by the kinetics of PbO reduction, only by the kinetics of electrochemical lead oxidation, and indicates that the system could be capable of producing electrical power from coal at 3.4 kWh on the basis of a fuel cost of $10 per ton i.e., with an overall efficiency of 42 percent.

3251 (PB--234561) RESEARCH ON ELECTRODES AND ELECTROLYTE FOR THE FORD SODIUM--SULFUR BATTERY. QUARTERLY REPORT, 1 JAN-31 MAR 1974. (Ford Motor Co., Dearborn, Mich. (USA); National Science Foundation, Washington, D.C. (USA)). Apr 1974. 112p. (NSF-RA/N--74-039). NTIS $8.75; $2.25 (mf).
SODIUM-SULFUR BATTERIES;ELECTRODES; ELECTROLYTES;SODIUM SULFIDES;ALUMINIUM OXIDES; SINTERING;FABRICATION;CORROSION;DESIGN; PERFORMANCE TESTING;RELIABILITY;TUBES

3252 (PB--234561) RESEARCH ON ELECTRODES AND ELECTROLYTE FOR THE FORD SODIUM--SULFUR BATTERY. QUARTERLY REPORT COVERING THE PERIOD JANUARY 1, 1974 TO MARCH 31, 19754. Petrocelli, J.V. (Ford Motor Co., Dearborn, Mich. (USA); Utah Univ., Salt Lake City (USA); Rensselaer Polytechnic Inst., Troy, N.Y. (USA)). Apr 1974. 117p. (NSF/RA/N--74-039). NTIS $8.75.
ELECTRODES;ELECTROLYTES;ALUMINIUM OXIDES; CERAMICS;SODIUM-SULFUR BATTERIES;CHEMICAL REACTION KINETICS;CORROSION;SINTERING;EXTRUSION; PRESSING;FABRICATION;HIGH TEMPERATURE; PERFORMANCE

3253 (PB--235484) RESEARCH ON ELECTRODES AND ELECTROLYTE FOR THE FORD SODIUM--SULFUR BATTERY. ANNUAL REPORT, 30 JUNE 1973--29 JUNE 1974. (Ford Motor Co., Dearborn, Mich. (USA)). Jul 1974. 287p. (NSF/RA/N--74-070). NTIS $8.75.
SODIUM-SULFUR BATTERIES;ELECTROLYTES; SULFIDES;CORROSION;ALUMINIUM OXIDES;TUBES; SINTERING;MECHANICAL PROPERTIES;ELECTRICAL PROPERTIES;PERFORMANCE TESTING;RAMAN SPECTRA; CATHODES;CERAMICS;ELECTRIC CONDUCTIVITY; CHEMICAL PREPARATION;HOT PRESSING;CHEMICAL REACTION KINETICS;MATERIALS;ELECTRODES

3254 (PB--238691) DEVELOPMENT PROGRAM FOR SOLID ELECTROLYTE BATTERIES. FINAL REPORT, 1 JANUARY 1973--30 JUNE 1974. (TRW Systems Group, Redondo Beach, Calif. (USA). Chemical Sciences Dept.). Oct 1974. 50p. (TRW--20078-6002-RU-00). NTIS $3.75.
SOLIDS;ELECTROLYTES;ALUMINIUM OXIDES;SODIUM-

SULFUR BATTERIES;OFF-PEAK ENERGY STORAGE; SINTERING;HOT PRESSING;CHEMICAL PREPARATION; ELECTRIC CONDUCTIVITY

3255 (PB--244289) RESEARCH ON ELECTRODES AND ELECTROLYTE FOR THE FORD SODIUM-SULFUR BATTERY. ANNUAL REPORT, 30 JUN 1974--29 JUN 1975. Weiner, S.A. (Ford Motor Co., Dearborn, Mich. (USA)). Jul 1975. Contract NSF-C805. 294p. NTIS $8.75.

Prepared in cooperation with Rensselaer Polytechnic Inst., Troy, N.Y., and Utah Univ., Salt Lake City. See also PB--235484 and PB--244290.

Significant research findings are reported on (1) the development of a binder system for extrusion and the preliminary extrusion of conductive beta'-$Al_2O_3$ tubing, (2) rapid sinter techniques in open-air environments at 1550-1600C in which soda evaporation is not a serious problem, (3) the hot-pressing of fine-grained (2-3 micrometers), high strength (35,000-40,000 psi), and low resistivity ([5 ohm-cm) polycrystalline beta'-$Al_2O_3$, (4) the relationship between strength and microstructural variables such as grain size and porosity and (5) the durability of ceramic in Na-Na cells run at high current densities. In the sulfur electrode development program, all work is proceeding on schedule. The sulfur-polysulfide melt was observed at 300C on both charge and discharge in the two-phase region. Both $Al_2O_3$ and $MoS_2$ have been found to be stable in $Na_2S_4$ melts at 400C. (GRA)

3256 (PB--244290) RESEARCH ON ELECTRODES AND ELECTROLYTE FOR FORD SODIUM-SULFUR BATTERY. APPENDIX A. LIST OF RESEARCH CONTRIBUTORS. REPORT FOR 30 JUN 1974--29 JUN 1975. (Ford Motor Co., Dearborn, Mich. (USA)). 31 Jul 1975. Contract NSF-C805. 243p. NTIS $7.50.

See also PB--244289. Prepared in cooperation with Rensselaer Polytechnic Inst., Troy, N.Y., and Utah Univ., Salt Lake City..

These appendicies include: A list of research contributors; report distribution list; research publications; fracture properties of polycrystalline lithia-stabilized B'-alumina; and the application of load-relaxation techniques to determine the stress intensity factor - crack velocity relationships in brittle materials. (GRA)

3257 (PB--244625) TECHNICAL AND MICROECONOMIC ANALYSIS OF CADMIUM AND ITS COMPOUNDS. FINAL REPORT ON TASK 1. Sargent, D.H.; Metz, J.R. (Versar, Inc., Springfield, Va. (USA)). Mar 1975. Contract DI-68-01-2926. 213p. NTIS $7.25.

The role of cadmium (and its compounds) in the environment and in the economy of the United States was studied, to evaluate the need for and the projected effect of controlling its production, use and dissipation. Technologically and economically feasible control alternatives were developed from a systematic documentation of cadmium production, uses, prevalence, and sources of pollution and an evaluation of the present and projected health hazards. Available information was then used directly to compare and optimize the various alternatives. The results led to two sets of recommended controls. The first, aimed at preventing increases in the present cadmium health hazards, consists of continued air and water pollution abatement, environmentally-sound land disposal of industrial wastes and residuals, and regulation of application rates to agricultural lands of cadmium-bearing materials. The second set of controls exhibits a more aggressive posture towards limiting cadmium dissipation, which could be implemented in the future should a more precise definition of the health hazard justify such a posture. (GRA)

3258 (PB--244648) SUBSTRUCTURE AND PROPERTIES OF SODIUM BETA-ALUMINA SOLID ELECTROLYTES. INTERIM REPORT. De Jonghe, L.C. (Cornell Univ., Ithaca, N.Y. (USA). Dept. of Materials Science and Engineering). Jul 1975. 54p. NTIS $4.25.

Sodium β-alumina solid electrolyte is the key component in sodium--sulfur batteries that are currently under development. The electrolytes that have been tested in prototype cells have been found to deteriorate more rapidly than is acceptable for a reliable commercial application. It is believed that this deterioration is connected with the impurities that were either introduced in the preparation of the electrolytes, or during its subsequent actual use, and does not reside in a fundamentally unstable nature of the electrolyte with respect to sodium or sodium polysulphides at its temperature of use. The object of this project is to establish which impurities are most detrimental, and to what levels they can be tolerated, to determine whether cost-effective load-leveling batteries with sodium β and β'' alumina electrolytes are a possibility. (GRA)

3259 (PB--247217) AC/DC POWER CONDITIONING AND CONTROL EQUIPMENT FOR ADVANCED CONVERSION AND STORAGE TECHNOLOGY. KEY PHASE REPORT NO. 1. Wood, P. (Westinghouse Electric Corp., East Pittsburgh, Pa. (USA)). Aug 1975. 362p. NTIS $10.50.

The objective of this project is to establish the best power conversion technology (technologies) applicable to a number of advanced energy storage conversion technologies, including a study of common conversion technology, modular approach to construction costs, research needed prior to practical application, and a preliminary design of the best technology. It was concluded that (1) a common technology can be applied to all sources considered (battery, fuel cell, superconducting magnetic energy storage (SMES), magnetohydrodynamic generation (MHD), and flywheels) excepting flywheels; (2) a current-fed, naturally commutated inverter is the best short term candidate; (3) a best long term candidate was not identified; (4) modularization will not yield cost benefits unless drastic constraints are applied; and (5) some conversion equipment cost reductions can be expected as a result of active device performance improvements. (GRA)

3260 (PB--252615) A NEW SULFUR DIOXIDE-FREE PROCESS FOR RECOVERING LEAD FROM BATTERY SCRAP. REPORT OF INVESTIGATIONS, 1976. Wilson, D.A. (Bureau of Mines, College Park, Md. (USA). College Park Metallurgy Research Center). Mar 1974. 19p. (BM-RI--8123). NTIS $3.50.

A laboratory method for processing lead battery scrap has been developed that eliminates virtually all of the $SO_2$ emission that normally is produced when using a conventional reverberatory or blast furnace. The method employs a hydrometallurgical step to convert the $PbSO_4$ to PbO and $CaSO_4$. Conversion is accomplished by mixing the battery scrap with a slurry of $Ca(OH)_2$. The reaction is exothermic and goes to completion in 2 to 5 minutes at room temperature. The dried product is mixed with a KCl-NaCl flux and carbon and reduced at 650 C. A minimum charge ratio of 3

parts of carbon to 100 parts of battery scrap is required for reduction. Lead recoveries as high as 95.0% have been achieved in the laboratory. The KCl-NaCl flux is recovered for recycling using a standard countercurrent water leach and evaporation process. (GRA)

3261 (PB--252827) RESEARCH ON ELECTRODES AND ELECTROLYTE FOR THE FORD SODIUM--SULFUR BATTERY. SEMIANNUAL REPORT, 30 JUN--30 DEC 1975. Weiner, S.A. (Ford Motor Co., Dearborn, Mich. (USA)). Jan 1976. 258p. NTIS $9.00.

See also PB--235484. Prepared in cooperation with Utah Univ., Salt Lake City, and Rensselaer Polytechnic Inst., Troy, N.Y..

In this report, further research findings are given on (1) the development of binder systems for extrusion and the preliminary extrusion of conductive β'-alumina tubing, (2) low- and high-temperature sintering methods, (3) mechanical properties of β'-alumina, especially its resistance to thermal shock, (4) the relationship between degree of conversion to β'-alumina, grain size, and conductivity, (5) the durability of β'-alumina in Na--S cells, (6) the improvement of cell rechargeability with the use of shaped porous electrodes, (7) the influence of impurities on ceramic degradation during cell operation, and (8) the use of coatings on metal or of inherently stable metal oxides in the design of the sulfur--polysulfide container. The cell testing program has yielded additional promising results, and more information has been accumulated concerning the reasons for cell failure. The oldest laboratory cell is now in its 18th month of operation, has passed over 1060 Ah/cm² discharge and completed more than 6400 cycles. (GRA)

3262 (PB--253164) DEVELOPMENT OF LITHIUM-METAL SULFIDE BATTERIES FOR LOAD LEVELING. PROGRESS REPORT. Sudar, S.; Heredy, L.A.; Ervin, G.; Hall, J.C.; Lai, S.C. (Atomics International Div., Canoga Park, Calif. (USA)). May 1976. 85p. NTIS $5.00.

The principal activities of the lithium--iron sulfide battery program include negative and positive electrode development, preparation and testing of lithium-resistant ceramic components and cell design, construction and operation. In the period covered in this report, positive electrode research and operation of a 100 Wh cell were conducted; a 150-Wh sealed cell employing four electrode pairs, each with a surface area of 110 $cm_2$, was designed, built, and placed in operation; and negative electrode research was performed. (GRA)

3263 (PB--255549) PREPARATION AND PROPERTIES OF BETA-ALUMINA/GLASS COMPOSITES. FINAL REPORT. Mackenzie, J.D. (California Univ., Los Angeles (USA). School of Engineering and Applied Science). Jun 1976. 44p. NTIS, PC A03/MF A01.

The purpose of project 254-1 was to fabricate glass-bonded beta-alumina composites for use in Na--S batteries. Samples were prepared by hot pressing various ionically conducting glasses with beta-alumina powders. The glassy phase served as a binder between the beta-alumina grains. Most of the binders, however, reacted with the beta-alumina, and a new crystalline phase was formed. Altering the processing conditions either enhanced or reduced the amount of reaction and influenced the electrical properties accordingly. These composites had beta-alumina as the continuous phase but their conductivities were lower than anticipated. Additional experiments were performed in order to determine the transport mechanisms. It appears that transport in these composites is controlled by sodium ion migration through the beta-alumina. The larger than predicted resistivities were thought to arise from poor contact between beta-alumina grains, where a large interparticle resistance severely hampers conduction. (GRA)

3264 (SAND--77-0411) USE OF HYSOL US0009 POLYURETHANE ENCAPSULANT IN BATTERY CABLES. Voida, G. (Sandia Labs., Albuquerque, N.Mex. (USA)). Apr 1977. Contract EY-76-C-04-0789. 31p. Dep. NTIS, PC A03/MF A01.

This report describes the evaluation of Hysol US0009 polyurethane as an encapsulant for the battery cable used on the MC1605B. The Hysol resin was selected for the application because it was reacted with a non-carcinogenic curing agent and because it exhibited superior mechanical, electrical, and hydrolytic properties over a wide temperature range. The Hysol encapsulant was evaluated to determine if it was superior to the EN-7 elastomer as a sealant against electrolyte migration to the interior of the cable. Environmental tests reported here showed the Hysol was marginal when no preseal was employed but was 100 percent effective when a bird-cage seal was used inside the EMR hardware. The EN-7 encapsulant, on the other hand, was effective only when seals were employed both inside the EMR hardware and at the lug terminations. Without the two preseals, the EN-7 compound was always unsatisfactory. Twenty development battery cables fabricated with Hysol under production operations were tested after alternate immersion in battery electrolyte and after exposures to temperature shock and the MIL-STD 202 environment. Presealed cables successfully survived these exposures and retained their initial DC resistance, insulation resistance, and high potential properties with only minor changes. The environmental tests conducted with these assemblies probably represented five or more years of in-field service. Comparative peel tests demonstrated that the Hysol/neoprene insert bond was twice (5.2 versus 2.8 kg/cm) that of the EN-7 polyurethane. Hysol US0009 has a potential for encapsulation of other WR components and assemblies in which the EN-7 resin has exhibited thermal shortcomings. 7 figures, 10 tables.

3265 (SC-DR--69-398) DESIGN, DEVELOPMENT, AND TESTING OF A CABLE ASSEMBLY FOR USE IN SEVERE ELECTROCHEMICAL ENVIRONMENTS. Voida, G. (Sandia Labs., Albuquerque, N.Mex. (USA)). Nov 1969. 41p. Dep. NTIS $5.28.

ELECTRIC BATTERIES;ELECTRIC CABLES;DESIGN; PERFORMANCE TESTING;POTASSIUM HYDROXIDES

3266 (TEC--75/006c, pp 65p., Task Report 8) RESOURCE AND ENVIRONMENT IMPACTS OF ELECTRIC CARS IN ST. LOUIS AND PHILADELPHIA. Sjovold, A.R. Sep 1975.

Impact of future use of electric cars in the St. Louis and Philadelphia regions. Volume III. Task reports on impact and usage analyses. Final report.

Several important environmental consequences that would accrue to electric car usage are discussed, including analyses of the impacts on material supplies and demands to produce and use electric cars, power plant thermal waste discharges, generation of radioactive wastes, generation of other solid and liquid wastes, and community noise pollution. The analyses are related to regional electric car

implementations in St. Louis and Philadelphia with comments on the implications of a nationwide implementation. The impact analyses span the period from 1980 to 2000, and are parametric in electric car usage with upper bound usage levels of 20 percent in 1980, 80 percent in 1990, and 100 percent in 2000. For very high regional electric car populations, significant additions to total U.S. demands of some materials will occur, depending on the battery technology employed. Critical material demands in this respect are nickel for nickel--zinc batteries, and lithium and graphite for lithium--sulfur batteries. For a large-scale nationwide implementation, critical material demands would arise for lead, antimony, nickel, titanium metal, lithium, and graphite. It is assumed that all of the metals will be highly recycled. Thermal waste discharges (i.e., waste heat) and radioactive wastes are projected to grow, commensurate with the baseline projections for electric power demand. Electric cars should increase slightly the solid and liquid waste problems, but potentially can reduce urban traffic noise.

3267 (UCID--17426-76-3) LITHIUM--WATER--AIR BATTERY PROJECT: PROGRESS DURING THE MONTH OF MARCH 1976. Cooper, J.F.; Hosmer, P.K. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1 Apr 1976. Contract W-7405-ENG-48. 12p. Dep. NTIS, PC A02/MF A01.

Controlling factors in the dissolution kinetics of the Li electrode in aqueous LiOH were investigated. Electrode potential was measured upon application of a galvanostatic or triangular wave current. The following conclusions were reached: the anodic dissolution of Li is controlled by activation polarization below a certain critical current density, i/sub lim/; i/sub lim/ increases with electrolyte flow rate; electrode resistance is independent of flow rate; above i/sub lim/ the concentration of LiOH in the diffusion layer exceeds the saturation concentration by an amount sufficient to cause the precipitation of LiOH on the electrode surface, and this action causes the electrode potential to rise; the electrode resistance of the activation-controlled region is 4 x $10^{-5}$ ohm-$m^2$. 5 figures. (RWR)

3268 (UCID--17426-76-4) LITHIUM--WATER--AIR BATTERY PROJECT: PROGRESS DURING THE MONTH OF APRIL 1976. Cooper, J.F.; Hosmer, P.K. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 30 Apr 1976. Contract W-7405-ENG-48. 9p. Dep. NTIS, PC A02/MF A01.

The kinetics of the Li electrode in LiOH(aq) was investigated. Electrode polarization was measured by voltammetric techniques. Graphs show the following results: anodic limiting current density increases with flow rate; limiting current density depends on flow rate and bulk electrolyte concentration; and electrode resistance is weakly dependent on flow rate. An intuitive model of mass transport-limited dissolution appears to be substantiated. The following tentative conclusions were reached: an upper limit to the rate of discharge of a lithium--water battery anode will be set by the mass transfer limitations of the flow system, and not by the kinetics of the charge transport within any microscopic surface films on the anode; the resistance of the anode surface film in the linear polarization region is quite low and essentially independent of flow rate; the plane parallel electrode geometry results in as low an electrode resistance as any so far investigated and should be considered for automotive battery design. 3 figures. (RWR)

3269 (UCID--17426-76-10) LITHIUM--WATER--AIR BATTERY PROJECT: PROGRESS DURING THE MONTH OF OCTOBER 1976. Cooper, J.F.; Hosmer, P.K.; Homsy, R.V. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 10 Nov 1976. Contract W-7405-ENG-48. 5p. Dep. NTIS, PC A02/MF A01.

Experimental work in the area of the ambient-temperature, steady-state behavior of the lithium electrode was completed. The following conclusions were drawn: 100 percent coulombic efficiency may be approached over a wide range of concentrations, flow conditions, and current densities; coulombic efficiency is approximately equal to I/sub e//I/sub l/, and I/sub e/ is the current in the external circuit, and I/sub l/ is the diffusion-limited current. Li electrode resistivities of (0.4 to 1.0) x $10^{-4}$ Ω-$m^2$ were obtained, and thus the plane-parallel configuration is suitable for batteries of the lithium-water type. Work on the characterization of Li/$I_2$ and Li/$Br_2$ analog batteries was begun. (RWR)

3270 (UCID--17457) INVESTIGATION OF THE KINETICS OF THE LI/LIOH(AQ) ELECTRODE: COULOMBIC EFFICIENCY, ELECTRODE POLARIZATION. Hosmer, P.K.; Cooper, J.F. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 13 Jan 1977. Contract W-7405-ENG-48. 46p. Dep. NTIS, PC A03/MF A01.

Experimental techniques and data from the investigation of electrode polarization and coulombic efficiency of the lithium/aqueous lithium hydroxide electrode are reported. 3 figures, 6 tables.

3271 (X--711-77-28, pp 223-244) NICKEL HYDROXIDE ELECTRODES. Dunlop, J. (COMSAT Labs., Clarksburg, MD). Nov 1976.

From 9. annual battery workshop; Greenbelt, Maryland, USA (9 Nov 1976).

1976 Goddard Space Flight Center battery workshop.

Work on nickel electrodes showing the effects of cyclic life is reported. Characteristics of electrochemically and chemically impregnated nickel oxide electrodes are compared. An analysis that breaks down the loading of the various electrodes on a percent by weight basis is also shown. A cross section of a conventional chemically impregnated electrode obtained by SEM indicates that active material moves from the center of the electrode toward the surface and compacts there after prolonged operation (3 years). There was a large increase in the micropore structure of the positive electrode as a result of the compacting of the active material. There is a large increase in void volume in the center of the electrode. The compacting at the electrode surface acts as a wicking device to suck electrolyte out of a nylon-type separator. During the lengthy discussion of this paper, the effects of Co in an electrochemically impregnated electrode on flooded cell cycling test was reported. A 5% addition increased cycle life by about a factor of 5. 5 figures. (RWR)

3272 (X--711-77-28, pp 317-326) DEVELOPMENT OF NICKEL OXIDE ELECTRODES FOR USE IN NICKEL--HYDROGEN CELLS. Puglisi, V.J. (Yardney Electric, Pawcatuck, CT). Nov 1976.

From 9. annual battery workshop; Greenbelt, Maryland, USA (9 Nov 1976).

1976 Goddard Space Flight Center battery workshop.

The program had two primary tasks: to

develop improved nickel oxide electrodes and to fabricate and deliver these electrodes. The aspects discussed in this paper are the plaque porosity and the loading level of the positive electrode. As a group, cells with 82% porous electrodes performed better than those with 78%; electrodes with a loading of 1.6 g/cm$^3$ performed as well as those with 1.9 g/cm$^3$. It was found that capacity did not improve during stabilization tests. The goal of 60 mAh/cm$^2$ of electrode in the back-to-back configuration was met. Capacity and utilization data for test cells are tabulated. 11 figures. (RWR)

3273 (ZfK--292) INFLUENCE OF THE CHEMICAL REACTION OF THE SOLID ELECTROLYTE MATERIAL WITH LIQUID SODIUM ON THE ELECTROMOTIVE FORCE OF SOLID ELECTROLYTE CELLS. Reetz, T. (Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden (German Democratic Republic)). Jul 1975. 8p. (In German). Dep. NTIS (US Sales Only), PC A02/MF A01.

By means of γ-active tracers it could be demonstrated that a new distribution of the microcomponents takes place during the sintering of homogeneously doped $ThO_2$--$Y_2O_3$ ceramics. Ru, Pt/Ir, Be, Ba, Mo are concentrated at the grain boundaries, Zr, Y and Ce remain homogeneously spread in the oxide matrix (sintering temperature 1760 °C). From the comparison of diffusion data and vapour pressures of the oxides a concentration results also for Al, Si and Mg at the grain boundaries during the sintering. The thorium oxide ceramics is in particular chemically attacked at the grain boundaries by oxide containing sodium. The impurities at the grain boundaries can be very harmful to the durability of the $ThO_2$--$Y_2O_3$ solid electrolyte ceramics.

3274 (ZfK--293) APPLICATION OF OXIDIC AND METALLIC PROTECTIVE LAYERS ON THE SOLID ELECTROLYTE TH/SUB 0.8/Y/SUB 0.2/O/SUB 1.9/. Reetz, T. (Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden (German Democratic Republic)). Jul 1975. 12p. (In German). Dep. NTIS (US Sales Only), PC A02/MF A01.

The analysis of the mass and charge transfer in the cell Na, $Na_2O(p'')$/protective layer/Th/sub 0.8/Y/sub 0.2/O/sub 1.9//$O_2(p')$ points out that large deviations from the theoretical emf appear with the application of both oxidic and metallic protective layers.

3275 BATTERY MONITORING SYSTEM ON BOTTOM. Battery Man; 19: No. 9, 26(Sep 1977).

A solid-state system for monitoring batteries on a Deep Submerging Rescue Vehicle is briefly described in general terms. It consists of a voltage scanner and a voltage detector unit. (RWR)

3276 MANUFACTURE OF BATTERY PLATES. Foulkes, S.C. (to Chloride Group Ltd.). US Patent 4,037,630. 26 Jul 1977. Priority date 18 Oct 1974, United Kingdom of Great Britain and Northern Ireland (UK). 38p.

There is disclosed a method for preparing enveloped plates for batteries by introducing an active material composition containing liquids into the porous envelope of the plate. The envelope is assembled on the current-conducting element of the plate by using an active material composition with a liquid content such that active material is filtered out by the porous envelope. A bed of active material is thus built up in the envelope, the bed building up from the end remote from that at which the composition is introduced back to the end at which the composition is introduced. Liquid issues through the walls of the envelope throughout the period that the bed is being built up. A variety of suitable active material compositions are described together with apparatus suitable for carrying out the method. 18 figures, 15 tables.

3277 UNDERSTANDING CHARGERS FOR MOTIVE-POWER BATTERIES: OPTIONAL FEATURES. Lambert, F.J. (Gould Inc,. Langhorne, PA). Plant Eng. (Barrington, Ill.); 31: No. 15, 163-164(21 Jul 1977).

Certain optional features that extend the versatility of a battery charger are described. These include series-charging cables, parallel-charging cables, remote charge control, sequence-charging assemblies, a charge-activated timer, and extra-long charging cables.

3278 ELECTRIC STORAGE BATTERY WITH VALVE METAL ELECTRODES. Nidola, A.; de Nora, V.; Spaziante, P.M. (to Diamond Shamrock Technologies SA). US Patent 4,037,032. 19 Jul 1977. Filed date 5 May 1976. 12p.

Electric storage batteries with titanium or other film-forming metal anodes and cathodes are provided. The anodes are coated with mixed oxide coatings of a film-forming metal oxide containing a platinum group metal oxide catalyst. The coatings may contain oxides of other metals to alter the breakdown voltage and increase the oxygen overpotential of the cathodes while preserving a low bromine and chlorine overpotential. The cathodes may be uncoated titanium or other film-forming metals or film-forming metals with a silver coating on them. Bipolar film-forming metal cathodes and anodes are provided carrying a mixed oxide coating on the cathodic face and either no coating or a silver coating on the anodic face. The invention is applicable to all types of electric storage batteries, either primary or secondary, and multiple batteries may be connected in series or in parallel to provide the desired amperage and voltage characteristics. 3 figures, 3 tables.

3279 BIPOLAR LEAD ACID BATTERY HAVING TITANIUM AND ZIRCONIUM ELECTRODE SUPPORTS. Jacob, W.R. (to Imperial Metal Industries (Kynoch) Ltd.). US Patent 4,037,031. 19 Jul 1977. Filed date 3 Jun 1975. 10p.

A bipolar lead--acid battery incorporates titanium and/or zirconium electrode supports and has a fiber filling to maintain a pressure on the active mass located on the supports. 4 figures, 1 table.

3280 SODIUM--SULFUR ELECTRIC BATTERIES WITH CERAMIC SPACER IN SULFUR COMPARTMENT. Evans, L.S.; Harbar, J.R. (to Secretary of State for Industry). US Patent 4,035,553. 12 Jul 1977. Filed date 6 Jul 1976. 8p.

A sodium-sulfur cell is provided having a ceramic spacer means disposed in the liquid sulfur compartment to provide a region substantially free from cathodic reactions. The spacer means is disposed adjacent to materials likely to be adversely affected by the cathodic reactions, such as glass seals used to join the solid electrolyte to a ceramic support member, or a metallic end cap provided to close the liquid sulfur compartment. 3 figures.

3281 LEAD BASE ALLOY FOR USE IN A STORAGE BATTERY GRID. Duddy, J.C.; Hein, E.R. (to ESB Inc.). US Patent 4,035,556. 12 Jul

1977. Filed date 7 Apr 1972. 6p.
A unique alloy comprising lead with small additions of zinc and tin is used to make grids for lead--acid cells. The alloy as produced is softer than is desirable. It is hardened by mechanical working. When properly worked, it has a strength and stiffness approaching that of other low--alloy lead materials currently in use as storage battery grids. 4 figures, 2 tables.

3282 METHOD FOR TESTING SEALS OF ELECTRICAL ENERGY STORAGE DEVICES. Ames, A.E.; Kniazzeh, A.G.; Goldberg, P. (to Polaroid Corp.). US Patent 4,034,598. 12 Jul 1977. Filed date 29 Mar 1976. 4p.
Seal integrity tests are conducted on electrical energy storage devices, such as batteries, by the application, to the device under test, of oxygen at elevated pressures. 2 figures, 1 table.

3283 PROCESS FOR CASTING A PLATE GRID FOR A LEAD--ACID STORAGE BATTERY. Okura, T.; Tatsumi, T.; Watanabe, H.; Murayama, H.; Kobayashi, Y. (to Shin-Kobe Electric Machinery Co., Ltd.). US Patent 4,034,793. 12 Jul 1977. Filed date 19 Jan 1976. 8p.
A process for casting a plate grid for a lead--acid storage battery comprises the steps of preparing a casting die assembly including two interengagable die halves between which is formed a casting cavity to cast a plate grid and pouring a molten metal of lead or lead alloy into the casting cavity to form the plate grid therein. Any air in the casting cavity is vented through gaps between the die halves and then through a narrow air passage in at least one venting member placed in either of the die halves so that the venting member is flush with the casting surface of the corresponding die half. The venting member at the top surface has cavity-forming portions operatively associated with the die halves. 9 figures.

3284 SELECTION OF THE NEGATIVE ELECTRODE FOR THE NICKEL--HYDROGEN SECONDARY CELL. Tsenter, B.I.; Dankova, I.S.; Veselova, S.S. (All-Union Scientific Research Inst. of Storage Batteries, Moscow). J. Appl. Chem. USSR (Engl. Transl.); 50: No. 1, 200-202(10 Jul 1977).
Translated from Zh. Prikl. Khim.; 50: No. 1, 206-208(Jan 1977).
The kinetics of the cell are examined. Dependence of the current density of oxygen ionization, variation of the charge and discharge voltage and wall temperature during charge, and partial potentiostatic curves for ionization of hydrogen and oxygen are shown for platinum and platinum--palladium hydrogen electrodes. It was found that the cell with the mixed platinum--palladium catalyst becomes heated much more quickly than the cell with the platinum-catalyzed hydrogen electrode. The corresponding discharge capacity of the former is substantially below that of the latter. In cell design, therefore, the ratio of the currents of hydrogen and oxygen ionization must be considered. The following conclusions were reached: the degree of charge of these cells is determined by the rate of the exothermic process of oxygen ionization at the hydrogen electrode, which also controls the thermal regime of operation of the cell; for selection of the optimal design of the hydrogen electrode, its activity in both hydrogen and oxygen ionization must be considered; catalytic bifunctional hydrogen electrodes with high ionization currents of both oxygen and hydrogen (e.g., Pt--Pd electrodes) can be used if diffusion of oxygen to the hydrogen electrode is artificially hindered. (RWR)

3285 UNDERSTANDING CHARGERS FOR MOTIVE-POWER BATTERIES: BASIC PRINCIPLES. Lambert, F.J. (Gould Inc,. Langhorne, PA). Plant Eng. (Barrington, Ill.); 31: No. 14, 107-108(7 Jul 1977).
Basic concepts concerning battery chargers are set forth. Early motor--generator chargers have been replaced by semiconductor types; the most common use ferro-resonant transformers and ''toper-charge'' control circuitry. The importance of properly matching the charger with the batteries to be charged is pointed out, and rules of thumb on this subject are given. A glossary of common battery charger terms is included. (RWR)

3286 PROCEDURE TO STABILIZE AN IRON AIR BATTERY. Lindstrom, O.B. (to AB Olle Lindstrom). US Patent 4,032,693. 28 Jun 1977. Filed date 27 Aug 1976. 6p.
An iron-air battery cell including positive and negative electrodes and an alkaline electrolyte is discussed. The positive electrode contains at least one of the metals cobalt, nickel, and silver. The negative electrode contains an electrochemically active iron. The electrolyte contains a sulphur-containing compound in a concentration of at least about 10 ppM and up to about 1,000 ppM, counted on the weight of the active iron material. 2 figures.

3287 METHODS OF PRODUCING ELECTRODES FOR ALKALINE BATTERIES. Beauchamp, R.L.; Maurer, D.W.; O'Sullivan, T.J. (to Bell Telephone Labs., Inc.). US Patent 4,032,697. 28 Jun 1977. Filed date 7 Nov 1975. 8p.
A process is described for making alkaline batteries in which particular attention is given to the pretreatment of nickel plaques prior to impregnation. This pretreatment involves production of a uniform thin oxide film on the nickel plaque surface under carefully controlled conditions. This pretreatment prevents corrosion under conditions for commercial production of electrodes for alkaline batteries, and permits, not only higher loadings, but more uniform loadings of the electrodes. 3 figures, 2 tables.

3288 ROAD SHOCK ENERGY CONVERTER FOR CHARGING VEHICLE BATTERIES. Schenavar, H.E. US Patent 4,032,829. 28 Jun 1977. Filed date 22 Aug 1975. 4p.
Energy, from road bed jolts, expended against the wheels and axle or axle housing of either a self-propelled or a trailer vehicle so as to cause the axle to rise and fall is transmitted to a rotatable shaft through a reciprocatory-to-rotary motion transformer. The transformer includes elongated double rack housings containing compression springs which engage shorter double racks that slide relative to their housings. Due to inertia and the time required to compress the springs, the motion of the racks lags behind the road-shock induced motions of their respective rack housings. The compressed springs expand and push their respective racks into the end spaces opened up within their respective housings, and thus the moving racks belatedly rotate their respective pinions, which are provided with oppositely-acting unidirectional clutches. The consequent intermittent rotation of the shaft is rendered continuous by a flywheel on the shaft. The rotation of the shaft drives an electric

current generator, the electric current output from which is fed to storage batteries, either the propulsion batteries of an electric vehicle or auxiliary storage batteries to charge these batteries. Compression springs engaging the ends of the racks, in addition to transmitting the road-shock-induced motions of the housings and axle to the clutches and shaft, also cushion the shocks which might otherwise damage the mechanism. 2 figures.

3289 SINTERED POROUS PLAQUE BATTERY PLATES AND METHOD OF MAKING SAME. Cromer, G.P.; Hazen, H.H.; Pensabene, S. (to General Electric Co.). US Patent 4,029,856. 14 Jun 1977. Filed date 30 Apr 1976. 10p.

A sintered porous plaque battery plate comprises an elongated substrate and a sintered porous plaque on both major surfaces. One longitudinal edge of the substrate has a region substantially free of porous plaque for welding a current collector to it. The other, opposed longitudinal edge of the substrate has a transversely tapered porous plaque region on both major surfaces of the plate adjacent and extending longitudinally of that edge for preventing the plaque from chipping along the edge. The method for forming such plates includes the steps of coating a substrate with double and single plate width strips of powdered metal slurry, forming a V-shaped groove longitudinally of each of the double width strips to define a tapered porous plaque region along one edge of each plate, and severing the substrate into strips of plate each with a tapered edge region after the slurry has been sintered into a porous plate. 8 figures, 1 table.

3290 PLANTE BATTERY PLATES. Battery Man; 19: No. 6, 15-16(Jun 1977).

The origin and characteristics of Plante battery plates are briefly summarized. Fabrication and forming of plates are discussed. (RWR)

3291 HIGH CONDUCTIVITY CUPROUS HALIDE--METAL HALIDE SYSTEMS. Matsui, T.; Wagner, J.B. Jr. (Northwestern Univ., Evanston, IL). J. Electrochem. Soc.; 124: No. 6, 937-940(Jun 1977).

The a-c electrical conductivity was measured for the systems CuI + $CdI_2$, CuCl + $CdCl_2$, CuI + KI, CuI + RbI, and CuCl + RbCl, and the results are discussed in relation to phase diagrams. New, highly conducting materials at room temperature were surveyed for the system, RbCl + CuCl. 4 figures, 5 tables.

3292 INVESTIGATIONS ON A HIGH CONDUCTIVITY SOLID ELECTROLYTE SYSTEM, RBCL + CUCL. Matsui, T.; Wagner, J.B. Jr. (Northwestern Univ., Evanston, IL). J. Electrochem. Soc.; 124: No. 6, 941-944(Jun 1977).

Solid electrolytes with high copper ionic conductivity and low electronic hole conductivity were found in the RbCl + CuCl system. The highest conductivity of $RbCu_3Cl_4$ [75 mole percent (m/o) CuCl] was $2.25 \times 10^{-3}$ $(\Omega\text{-cm})^{-1}$ at 25°C. The conductivity was measured as functions of temperature and of composition. X-ray patterns and thermal analyses indicate that the material is a new compound and not a mixture of the constituents. 6 figures, 2 tables.

3293 ACCUMULATOR BATTERY APPARATUS AND METHOD. von Krusenstierna, O. (to Aktiebolaget Tudor). US Patent 4,025,698. 24 May 1977. Priority date 9 Oct 1970, Sweden. 8p.

There is disclosed rechargeable accumulator battery apparatus in which either the zinc anode part or the porous separator part of each cell is vibrated in its own plane to produce macro- and microturbulence effects in the surrounding electrolyte to inhibit the occurrence of irregular zinc deposits on the anode in the course of repeated charge cycles. In one form, the amplitude of vibration appropriate during the charging of the particular battery is fixed mechanically by an eccentric element rotatably mounted in a permanent fashion on the battery case and adapted to be coupled to externally located motor means having a rotary power output. 4 figures.

3294 METHOD AND DEVICE FOR CHARGING AND HEATING AT LOW TEMPERATURE A SEALED STORAGE CELL BATTERY. Godard, P.; Prevot, C. (to Saft-Societe des Accumulateurs Fixes et de traction). US Patent 4,025,861. 24 May 1977. Priority date 23 Aug 1974, France. 6p.

In this method for charging a sealed storage cell battery, the battery is heated when its temperature lies below a determined value. The intensity of the charge current is lowered by being shunted to heat the battery when the voltage of the battery reaches a given value. That value of the voltage of the battery supplies the signal which causes the heating of the battery. A device for implementing the method is explained. 2 figures.

3295 LEAD STORAGE BATTERY ELECTRODE AND METHOD. Sundberg, E.G. (to Aktiebolaget Tudor). US Patent 4,025,701. 24 May 1977. Priority date 18 Apr 1972, Sweden. 4p.

A tube plate-type electrode for a storage battery is described. The metal rod of the tube is held centrally in a surrounding sheath by spacing fins. The surface of the spacing fins is coated with a lacquer to reduce the peak effect caused by high current density to prolong the life of the tube sheath. 4 figures.

3296 BATTERY WITH SILICON METAL ANODES. McKaveney, J.P. (to Hooker Chemicals and Plastics Corp.). US Patent 4,024,322. 17 May 1977. Filed date 24 Mar 1975. 4p.

Anodes which exhibit electrochemical potentials comparable to zinc are prepared from alloys formed from silicon together with one or more highly reactive elements which are unstable when introduced along into water. The highly active element component of the alloy is preferably selected from the group consisting of calcium, barium, magnesium, cerium, and strontium. Preferably, the active element or elements comprise from about 5 to about 65 percent of the alloy. 2 tables.

3297 BATTERY SEPARATOR. Versteegh, W.M. (to Evans Products Co.). US Patent 4,024,323. 17 May 1977. Filed date 19 Apr 1976. 8p.

A battery separator comprises a microporous sheet formed substantially of a mixture of polymeric constituents. One of the polymeric constituents is an ultrahigh-molecular-weight polyolefin having a standard load melt index of substantially 0 and an intrinsic viscosity greater than about 3.0. The other polymeric constituent is either a copolymer of an olefin and an ethylenically unsaturated monocarboxylic acid selected from the group consisting of acrylic acid and methacrylic acid, or a blend of a low-molecular-weight polyolefin and a polymer of acrylic or methacrylic acid.

3298 ALKALI METAL-SULFUR CELLS. Tilley, A.R. (to Chloride Silent Power Ltd.). US Patent 4,024,321. 17 May 1977. Priority date 3 Jul 1975, United Kingdom of Great Britain and Northern Ireland (UK). 2p.

An alkali metal--sulfur cell of tubular form has an inner tubular member constituting the solid electrolyte, an outer tubular member, and a current collecting pole extending into the interior of the inner tubular member (which forms the cathode compartment of the cell). The outer tubular member, the inner tubular member, and the current collecting pole have shoulder formations which abut one another through sealing means, and are urged towards one another by axially acting spring means.

3299 ZINC ELECTRODES FOR SECONDARY BATTERIES. Charkey, A. (to Energy Research Corp.). US Patent 4,022,953. 10 May 1977. Filed date 22 Aug 1975. 8p.

Electrodes containing zinc active material include a cadmium additive enhancing adherence of the electrode for zinc electroreduced from the solid zinc compound state or deposited thereon from electrolytes. Zinc alkaline batteries employing such electrodes exhibit extended discharge--recharge cycling capacity. 2 figs.

3300 (SAND--77-6008) LITHIUM ION CONDUCTIVE ELECTROLYTE COMPOSITION. Ikeda, H.; Narukawa, S. May 1977. Translation by H. Kubota of Japanese Patent No. 1974/81898. 7p. Dep. NTIS, PC A02/MF A01.

A solid electrolyte for the lithium family of batteries is proposed which has a high lithium ion conductivity. It comprises a solid solution of lithium sulfate and lithium hydroxide. 3 figures. (DLC)

3301 INVESTIGATION OF THE SURFACE STRUCTURE OF SOME LEAD DIOXIDE AND RELATED ELECTRODES. Casson, P. (Univ. of Loughborough, Eng.); Hampson, N.A.; Peters, K.; Whyatt, P. J. Appl. Electrochem.; 7: No. 3, 257-265(May 1977).

S.E.M. observations were carried out on $PbO_2$ and related electrodes after electrochemical reaction in 5 M $H_2SO_4$. The morphology of the surfaces examined is strongly affected by their history, particularly their charge/discharge cycles. $PbSO_4$ formed by the self-corrosion process is much more porous than that formed by the electrochemical reduction of $PbO_2$. 13 figs.

3302 POINT OF PASSIVATION OF A ZINC ELECTRODE IN ALKALI. Marhall, A. (Ciba-Geigy Ltd., Simonsway, Eng.); Hampson, N.A. J. Appl. Electrochem.; 7: No. 3, 271-273(May 1977).

Confirmatory evidence is provided that at the point of passivation of solid zinc in alkali there is no free $OH^-$ in the reaction layer at the electrode. 2 figs.

3303 (SAND--77-6009) LITHIUM ION CONDUCTIVE ELECTROLYTE COMPOSITION. Ikeda, H.; Narukawa, S. May 1977. Translation by H. Kubota of Japanese Patent 1974-81899. 7p. Dep. NTIS, PC A02/MF A01.

A solid electrolyte for a lithium battery is disclosed. It is a three-component system with the general formula $Li_2SO_4$--LiOH--LiI. This substance has a low conductivity at low temperatures, but the conductivity increases sharply above 170°C and assumes the high value of 5 x $10^{-2}$ (OMEGA cm)$^{-1}$ at 200°C. Appropriate compositions range as follows: 30 to 45 mol percent $Li_2SO_4$, 30 to 45 mol percent LiOH, and 10 to 40 mol percent LiI. Fabrication of this material and the design and performance of a battery in which it may typically be used as electrolyte are explained. 3 figures. (RWR)

3304 CLAMPING STRUCTURE FOR BATTERY CELLS. Selinko, G.J. (to Motorola, Inc.). US Patent 4,020,244. 26 Apr 1977. Filed date 3 Mar 1976. 4p.

A structure for clamping a plurality of battery cells to prevent their deformation includes a pair of pressure plates positioned against the ends of a stack of battery cells and a plurality of bands which extend around the cells and the end plates to hold the end plates in fixed position with respect to each other. The structure can be used with a plurality of sealed cells of rectangular configuration to prevent expansion of the cells of the type where pressure can build up therein, such as Ni-Cad rechargeable batteries, and thereby prevent bulging of the electrodes of the cells to injure them. The pressure plates can be made of steel to serve also as heat sinks during welding of the bands, and the bands can be formed of steel strips which are preferably cinched tight about the cells and welded together. Partitions can be positioned between adjacent cells, with edges welded to the bands to prevent expansion of the cells in a direction parallel to the pressure plates.

3305 CYCLIC VOLTAMMETRY ON LEAD ELECTRODES IN SULPHURIC ACID SOLUTION. Visscher, W. (Eindhoven Univ. of Tech., The Netherlands). J. Power Sources; 1: No. 3, 257-661(Apr 1977).

The oxidation of lead in 5 M $H_2SO_4$ was studied by cyclic voltammetry. When a potential scan is applied from 1.0-V to 2.6-V vs. R.H.E., the $PbSO_4/PbO_2$ oxidation peak can be observed in the anodic voltammogram provided the scan rate is 0.16 mV/s or lower. When the potential scan is restricted to the potential range +0.6 V to +2.6 V, the anodic voltammogram shows two peaks, which were assigned to the formation of $\alpha$-$PbO_2$ and $\beta$-$PbO_2$, respectively. This $\alpha$-$PbO_2$ is formed underneath the $PbSO_4$ film. During the reverse sweep the main reduction peak at 1.65 V corresponds with the reduction of $\beta$-$PbO_2$ to $PbSO_4$. $\alpha$-$PbO_2$ is not reduced at a definite potential, but it is reduced to n-PbO.$PbSO_4$ with n increasing from the oxide--electrolyte interface towards the interior of the electrode and with more cathodic potential. At potentials below 0 V, the basic lead sulfates are reduced. The effect of the addition of small amounts of $H_3PO_4$ to $H_2SO_4$ electrolyte during the potential scanning results in an increase of the $\alpha$-$PbO_2$ peak and a disappearance of the $\beta$-$PbO_2$ peak. 6 figures

3306 DISCHARGE REACTION MECHANISM OF THE $MOO_3$ ELECTRODE IN ORGANIC ELECTROLYTES. Besenhard, J.O. (Technische Univ., Munich); Schoellhorn, R. J. Power Sources; 1: No. 3, 267-276(Apr 1977).

Discharge and charge reactions of $MoO_3$ electrodes in organic $Li^+$ electrolytes are shown to be reversible topotactic redox processes of layered molybdenum bronzes Li/sub x/+ [$MoO_3$)/sup x/- The kinetically accessible charge range amounts to 0.1 less than or equal to x less than 1.5 with the lower limit of x depending on the precedent cathodic load. Complete re-oxidation to the binary oxide is kinetically hindered, presumably as a result of small structural changes. The process is strongly affected by the size of the electrolyte cation, whereas no dependence on

the anion species was observed. Reduction beyond x = 1.5 is at least partially associated with irreversible changes in the oxide structure. Similar reactions were found for non-stoichiometric molybdenum oxides, e.g., $Mo_{18}O_{52}$ and $Mo_8O_{23}$. 8 figures.

3307 OXIDATION OF COPPER-CONTAINING FILMS AT ROOM TEMPERATURE. Greenberg, C.B. (PPG Industries, Inc, Glass Res Cent, Pittsburgh). J. Electrochem. Soc.; 124: No. 4, 496-500(Apr 1977).

In a previous publication, formation of a novel copper-containing, electroless-replacement film was described. Partial replacement of electroless copper was from an aqueous $Ag^{+}$-$S_2O_3^{-2}$ solution. The emphasis was on an accompanying, accelerated oxidation reaction in the air, which was also shown to occur after electroless copper was exposed to a solution containing only sodium thiosulfate. Additional data are described to elaborate the synergistic dependence of the oxidation of Cu in these films on two impurities, one probably a sulfide, and the other $H_2O$ from the air. These new data show that oxidation in air can be very much inhibited by prior exposure to extra dry $O_2$ despite the otherwise very strong propensity for oxidation. This suggests some probable mechanisms relative to cationic diffusion and the Cabrera-Mott model for oxide growth.

3308 RECHARGEABLE ELECTRIC ACCUMULATOR CELL WITH AT LEAST ONE ZINC ELECTRODE. von Krusenstierna, O. (to Akriebolaget Tudor). US Patent 4,015,053. 29 Mar 1977. Filed date 1 Dec 1975. 4p.

An improvement in accumulator batteries having a zinc anode and an oxide cathode (e.g., nickel oxide or silver oxide cathode) is disclosed. The zinc anode and/or separator part between the anode and cathode is vibrated at a frequency and amplitude sufficient to inhibit dendrite growth on the zinc anode. The electrolyte contains excess zinc such that solid zinc oxide is present in the fully charged condition. The separator may be provided with circulation enhancement means. The resulting batteries have long life with a large number of charging and discharging cycles. 2 figures.

3309 METHOD OF PREPARING A NEGATIVE ELECTRODE INCLUDING LITHIUM ALLOY FOR USE WITHIN A SECONDARY ELECTROCHEMICAL CELL. Tomczuk, Z.; Olszanski, T.W.; Battles, J.E. (to Energy Research and Development Administration). US Patent 4,011,372. 8 Mar 1977. Filed date 9 Dec 1975. 6p.

PAT-APPL-639,133.

A negative electrode that includes a lithium alloy as active material is prepared by briefly submerging a porous, electrically conductive substrate within a melt of the alloy. Prior to solidification, excess melt can be removed by vibrating or otherwise manipulating the filled substrate to expose interstitial surfaces. Electrodes such as solid lithium--aluminium filled within a substrate of metal foam are provided. 1 figure, 1 table.

3310 UNCHARGED POSITIVE ELECTRODE COMPOSITION. Kaun, T.D.; Vissers, D.R.; Shimotake, H. (to Energy Research and Development Administration). US Patent 4,011,373. 8 Mar 1977. Filed date 29 Apr 1976. 8p.

PAT-APPL-681,649.

An uncharged positive-electrode composition contains particulate lithium sulfide, another alkali metal or alkaline earth metal compound other than sulfide, e.g., lithium carbide and a transition metal powder. The composition along with a binder, such as electrolytic salt or a thermosetting resin, is applied onto an electrically conductive substrate to form a plaque. The plaque is assembled as a positive electrode within an electrochemical cell opposite to a negative electrode containing a material such as aluminum or silicon for alloying with lithium. During charging, lithium alloy is formed within the negative electrode and transition metal sulfide such as iron sulfide is produced within the positive electrode. Excess negative electrode capacity over that from the transition metal sulfide is provided due to the electrochemical reaction of the ''other than sulfide'' alkali metal or alkaline earth metal compound. 2 figures, 1 table.

3311 POROUS CARBONACEOUS ELECTRODE STRUCTURE AND METHOD FOR SECONDARY ELECTROCHEMICAL CELL. Kaun, T.D. (to Energy Research and Development Administration). US Patent 4,011,374. 8 Mar 1977. Filed date 2 Dec 1975. 12p.

PAT-APPL-636,882.

Positive and negative electrodes are provided as rigid, porous carbonaceous matrices with particulate active material fixedly embedded. Active material such as metal chalcogenides, solid alloys of alkali metal or alkaline earth metals along with other metals and their oxides in particulate form are blended with a thermosetting resin and a solid volatile to form a paste mixture. Various electrically conductive powders or current collector structures can be blended or embedded into the paste mixture which can be molded to the desired electrode shape. The molded paste is heated to a temperature at which the volatile transforms into vapor to impart porosity as the resin begins to cure into a rigid solid structure. 2 figures, 3 tables.

3312 RARE EARTH COBALTITES AS OXYGEN ELECTRODE MATERIALS FOR ALKALINE SOLUTION. Kudo, T.; Obayashi, H.; Yoshida, M. (Hitachi, Ltd., Tokyo). J. Electrochem. Soc.; 124: No. 3, 321-325(Mar 1977).

The perovskite-type compounds Ln/sub 1-x/M/sub x/M'$O_3$ (Ln = lanthanoid element, M = alkaline earth element, M' = transition metal element) are examined as oxygen electrode materials for an alkaline solution. A porous sintered electrode consisting of a compound like Nd/sub 1-x/Sr/sub x/$CoO_3$ (x = 0.2) is satisfactory in both polarization characteristics and stability under working conditions. However, a polytetrafluoroethylene (PTFE)-bonded-type electrode barely functions as an oxygen electrode even at a current density as low as 10 mA/cm$^2$. The electrode oxide undergoes reduction instead of acting as a reduction catalyst for gaseous oxygen to hydroxy ions. From a practical point of view, the sinter-type electrodes are promising as metal--air secondary battery cathodes because they are stable to anodic oxidation during charge periods. 9 figures.

3313 NEW NIOBIUM SELENIDE CATHODE FOR NONAQUEOUS LITHIUM BATTERIES. Murphy, D.W.; Trumbore, F.A.; Carides, J.N. (Bell Telephone Labs., Murray Hill, NJ). J. Electrochem. Soc.; 124: No. 3, 325-329(Mar 1977).

The $\gamma$-''$NbSe_4$'' phase, with a single phase composition range $NbSe_{4.0}$ to $NbSe_{4.5}$, is shown to behave as an electrochemically active,

reversible cathode material in nonaqueous lithium cells. The cell data, together with the results of n-butyl lithium reaction studies, indicate a topotactic reaction to give an $Li_xNbSe_{sub\ 4\ +\ x/}$ ($x = 0$ to 0.5) discharge product. Cycle data are presented for nonaqueous lithium cells with cathodes of either $NbSe_4$ containing small amounts of fibrous $NbSe_3$ or hot-pressed composites of $NbSe_{sub\ 4\ +\ x/}$ with graphite and polyethylene. 9 figures.

3314 GROWTH OF MONOCRYSTALS OF THE GALLIUM ANALOG OF BETA''-$AL_2O_3$ BY $NA_2O$ EVAPORATION. Foster, L.M.; Scardefield, J.E. (IBM Watson Research Center, Yorktown Heights, NY). J. Electrochem. Soc.; 124: No. 3, 434-436(Mar 1977).

A crystal growth practice was developed for producing monocrystals of the gallium analog of β''-$Al_2O_3$. The method involves evaporation of $Na_2O$ from a molten $Na_2O$--$Ga_2O_3$ charge held in a boat that is located in a furnace with a steep temperature gradient so that the product grows from one end. Monocrystals up to about 1 cm in size were grown. Their composition is $Na_2O$ x $5.7Ga_2O_3$, which corresponds to 96.5% occupancy of the available Na sites. The space group in R3m and the lattice parameters are a = 5.84A and c = 34.53A.

3315 EFFECT OF SOME INORGANIC ADDITIVES ON THE CYCLE LIFE OF THE POSITIVE ELECTRODES IN THE LEAD-ACID CELL. Abdul Azim, A.A.; Ismail, A.A. (National Research Centre, Cairo). J. Appl. Electrochem.; 7: No. 2, 119-125(Mar 1977).

The effect of $Sb_2O_3$, $As_2O_3$ and $P_2O_5$ on the cycle life of the lead--acid cell was studied with the help of a small cell which avoids the complicating factors encountered in a complete cell. The behavior of the active mass in the absence and presence of different concentrations of the additives was compared with the corresponding behavior of pure α- and β-$PbO_2$. X-ray as well as microscopic examinations of the active mass were carried out. It was shown that $Sb_2O_3$ (and to a lesser extent $As_2O_3$) enhance the oxidation of basic sulphate into α-$PbO_2$. The latter modification yields double the capacity than that obtained for β-$PbO_2$. 5 figures.

3316 UNIVERSAL INPUT BATTERY CHARGER. Dobie, A.B. Electron. Eng.; 49: No. 589, 31(Mar 1977).

A circuit is described which is capable of creating a low-cost battery charging system which in one mode will accept ac inputs from 100-250 V, and in the other mode will accept ac/dc inputs from, say, 10-30 V. The object is to produce a virtually constant charging current from almost any world line supply or from car/caravan/boat supplies.

3317 WRAPPED-ELECTRODE BATTERY. Schenk, G.; Haake, H. (to Varta Batterie Aktiengesellschaft). US Patent 4,009,053. 22 Feb 1977. Priority date 9 Aug 1974, German, Federal Republic of (F.R. Germany). 2p.

A wrapped battery electrode is connected to the current take-off conductor by projections from radial slots in the conductor which engage the rim of the electrode. The projections are formed in the course of the punching operation which forms the slots. 3 figures.

3318 STORAGE BATTERY COMPRISING POSITIVE ELECTRODE OF A GRAPHITE AND LITHIUM FLUORIDE COMPOUND. Bennion, D.N.; Hebbar, R.K.; Deshpande, S.L. (to Secretary of the Navy). US Patent 4,009,323. 22 Feb 1977. Filed date 12 May 1975. 10p.

A positive electrode of a storage battery is formed by applying an electrical charge through a nonaqueous lithium perchlorate solution to an electrode formed of powdered ''Madagascar''-type graphite and lithium fluoride. 1 table.

3319 SHEATH FOR TUBULAR STORAGE BATTERY ELECTRODES AND METHOD FOR THEIR PRODUCTION. Sundberg, E.G.; Westberg, E. (to Aktiebolaget Tudor). US Patent 4,008,100. 15 Feb 1977. Priority date 17 Dec 1973, Sweden. 8p.

A sheath for tubular storage battery electrodes has an inner layer of an inert fibrous material and an outer layer of thermoplastic material in the form of a net, perforated foil, or the like. The two layers are mechanically joined by heating the fibrous layer to a temperature sufficient to soften the adjacent surface of the thermoplastic material and cause a portion of the fibrous layer to be embedded in the surface of the thermoplastic layer. 9 figures.

3320 PRESSURE VENT-SEALED PRIMARY AND SECONDARY ALKALINE CELLS. Fitchman, A.; Wyatt, T.D. (to P. R. Mallory and Co., Inc.). US Patent 4,008,354. 15 Feb 1977. Filed date 12 May 1975. 6p.

An extrudable hot melt adhesive material is utilized in a low-cost vent for an electrochemical cell to relieve abnormal pressure formed during improper use of the cell. The extrudable hot melt adhesive material is suitably joined or bonded to a member used to provide a cell top, and covers and fills a vent hole formed in the member. Material is extruded through the vent hole by abnormal pressure to open the vent hole and allow the abnormal pressure to be released through the opened vent hole. The venting pressure can be predetermined by varying vent hole diameter, amount of adhesive, and the composition of the filler adhesive material with respect to viscosity. 3 figures.

3321 BATTERY CELL COOLING SYSTEM. Brinkmann, J.; Franke, H. (to Varta Batterie Aktiengesellschaft). US Patent 4,007,315. 8 Feb 1977. Priority date 27 Mar 1974, German, Federal Republic of (F.R. Germany). 14p.

Multicell battery cooling is accomplished by cooling elements immersed in the cell-top electrolyte. The elements have high heat conductivity and electrical resistance. The cooling medium has low electrical resistance. Various configurations of circulatory flow paths provide various utilizations for the medium beyond that of cooling the cells. 12 figures.

3322 LEAD BASE CADMIUM--TIN ALLOY USEFUL FOR FORMING BATTERY COMPONENTS. Rao, P.; Mao, G.W. (to Gould Inc.). US Patent 4,007,056. 8 Feb 1977. Filed date 23 May 1975. 6p.

A cadmium--tin--lead alloy composition containing at least 0.4 percent by weight of both cadmium and tin is used for forming the straps employed which weld together the lugs of the grids in lead--acid storage batteries. The relatively small amount of cadmium and tin provide a large volume fraction of a cadmium--tin eutectic phase that is low melting and serves to facilitate the welding. This alloy composition may also be used to form intercell connectors and terminal posts for such batteries. 3 figures, 1 table.

3323 PLASTIC CASE FOR FLAT RECHARGEABLE CELL. Sorensen, D.D.; Erickson, R.A.; Iepson, H.E. (to Gould Inc.). US Patent 4,007,060. 8 Feb 1977. Filed date 30 May 1975. 4p.

A flat, sealed case for a secondary cell includes a flat shallow plastic base and a thin, flat plastic cover. The periphery of the cover is sealed to the base. The case includes at least one internal restraint to prevent bulging of the flat cover and base upon a build-up of internal pressure within the cell case, for example, during recharging. 6 figures.

3324 ELECTROCHEMICAL CELL ELECTRODE SEPARATOR AND METHOD OF MAKING IT AND FUEL CELL CONTAINING SAME. Witherspoon, R.R.; Domanski, E.M.; Davis, J.A. (to General Motors Corp.). US Patent 4,007,059. 8 Feb 1977. Filed date 20 Aug 1975. 10p.

An ion-permeable material particularly useful for electrode separators is discussed. The material is a uniform mixture of 30 to 70 percent by weight colloidal-size asbestos fibers and 20 to 40 percent by weight unsintered fine polytetrafluoroethylene fibers, bonded together with uniformly dispersed particles of a fluorinated ethylene--propylene copolymer comprising about 5 to 15 percent by weight of the material. Colloidal size particles of an alkaline earth metal oxide are dispersed throughout the material. The material is initially prepared in a modified paper making process and then heated to a temperature high enough to fuse the fluorinated ethylene--propylene copolymer but not high enough to sinter the polytetrafluoroethylene fibers. An improved zinc--air hybrid fuel cell and an improved silver oxide--zinc secondary battery are made possible with electrode separators such as these. 4 figures.

3325 COMPARISON OF THE THERMAL STABILITY OF A BETA- AND BETA''-ALUMINA AT HIGH PRESSURES. Roth, W.L.; DeVries, R.C. (General Electric Co., Schenectady, NY). J. Solid State Chem.; 20: No. 2, 111-118(Feb 1977).

The high-pressure thermal stability of $Na^+$ β-alumina and magnesium-stabilized $Na^+$ β''-alumina was studied from 5 to 50 kb and from room temperature to 1400°C. Above 5 kb and 560°C, $Na^+$ β-alumina decomposes into α-$Al_2O_3$ and $NaAlO_2$. Magnesium-stabilized $Na^+$ β''-alumina decomposes at slightly higher temperatures to α-$Al_2O_3$, $MgAl_2O_4$, and probably $NaAlO_2$. Estimates of activation volume and enthalpy support a model for decomposition that depends on cation vacancies and proceeds by sodium diffusion in quasi-liquid conduction planes. 5 figures, 1 table.

3326 REACTION OF THE GALLIUM ANALOG OF BETA''-ALUMINA WITH WATER. Foster, L.M.; Arbach, G.V. (Watson Research Center, Yorktown Heights, NY). J. Electrochem. Soc.; 124: No. 2, 164-167(Feb 1977).

The reaction of the gallium analog of β''-$Al_2O_3$ with moisture was investigated. This material in finely divided form reacts rapidly with moisture from humid atmospheres to pick up approximately 1 mole of water for each gram-atom of sodium. The water uptake is accompanied by an expansion in the c axis of 11 to 12%. Monocrystals of the β''-gallate do not show measurable water pickup, and particles of intermediate sizes show intermediate degrees of pickup. The size effect is explained as peripheral attack of water on the crystal, which ceases after a fixed penetration depth. An association of water molecules with the sodium ions to form a complex such as $(NaH_2O)^+$, which increases the coordination of the site, is suggested as the reaction mechanism. 3 figs.

3327 BEHAVIOR OF LEAD ALLOYS AS $PbO_2$ ELECTRODES. Sharpe, T.F. (General Motors Corp., Warren, MI). J. Electrochem. Soc.; 124: No. 2, 168-173(Feb 1977).

An understanding of the corrosion behavior of lead alloys is important because grid corrosion affects the cycle life of the positive plate of the lead--acid battery. Comparisons between pure lead, lead--antimony, and lead--arsenic alloys in various electrochemical studies are discussed in terms of effects of the alloying element on the development and subsequent discharge behavior of $PbO_2$ in $H_2SO_4$ electrolyte. 10 figs., 1 table.

3328 TRANSIENT RESPONSE OF THE SULFUR/POLYSULFIDE ELECTRODE BASED ON A VARYING CONCENTRATION MODEL. Kao, Y.K.; Wayner, P.C. Jr. (Rensselaer Polytechnic Inst., Troy, NY). J. Electrochem. Soc.; 124: No. 2, 230-236(Feb 1977).

A computer simulation of the transient behavior of the sulfur electrode of a Na/S battery operating in the single phase region was obtained. The results show the relative effect of concentration and conductivity on the cell performance. The predominant effect is due to the variation of the chemical potential of sulfur with concentration, which causes the cell to operate uniformly. This advantage is partially offset by high current densities, large cell dimensions, and unmatched melt and felt conductivities. Capacity loss, which has been experimentally observed, is theoretically demonstrated. 10 figs.

3329 INVESTIGATION INTO THE IMMOBILIZATION OF THE SODIUM ELECTRODE IN THE SODIUM--SULFUR BATTERY. Knoedler, R.; Baukal, W.; Kuhn, W. (Battelle-Institute eV, Frankfurt am Main). J. Electrochem. Soc.; 124: No. 2, 236-237(Feb 1977).

The negative electrode in the sodium--sulfur battery consists of liquid sodium at a temperature of 300° to 400°C. Investigations were carried out in order to study whether liquid sodium can be immobilized without influencing the electrical performance of the electrode. It was found that immobilization of the Na can be achieved without major influence on the performance of the Na electrode and, hence, the battery. (RWR) 1 fig.

3330 SINTERING PROCESSES AND HEAT TREATMENT SCHEDULES FOR CONDUCTIVE, LITHIA-STABILIZED BETA''-$AL_2O_3$. Youngblood, G.E.; Virkar, A.V.; Cannon, W.R.; Gordon, R.S. (Univ of Utah, Salt Lake City). Am. Ceram. Soc. Bull.; 56: No. 2, 206-210, 212(Feb 1977).

The manufacture of the ceramic electrolyte for sodium-sulfur batteries with a uniform and fine microstructure is studied. Sintering and annealing schedules are described for fabrication of dense, strong and conductive polycrystalline ceramic bodies. Sintering techniques described can be readily adapted to rapid and economical fabrication of β''-$Al_2O_3$ tubing from commercial sources of α-$Al_2O_3$ powder. To enhance conversion kinetics, a more effective method of distributing lithium in the powder compact was devised; zeta lithium aluminate ($Li_2O$:5$Al_2O_3$) was used as the source of $Li_2O$. Improved lithia distribution permitted conversion to proceed more rapidly during sintering and led to development of

microstructures with small grain sizes.

3331 STUDY OF THE ELECTROCHEMICAL PROPERTIES OF SOLID-STATE CONJUGATED AMINES WITH RESPECT TO THEIR USE AS ELECTRODE ACTIVE MATERIALS IN SECONDARY BATTERIES. Dufeu, J.F.; Matricali, G.; Dieng, M.; Guillou, M. (Univ., Paris). C. R. Hebd. Seances Acad. Sci., Ser. C; 284: No. 5, 223-226(31 Jan 1977). (In French).

Solid electrodes composed of a solid-state mixture of substituted conjugated amines and lamp black were studied in the presence of an aqueous electrolytic solution. In a mixture, 3M potassium chloride, durene diamine, and orthodianisidine bring about a reversible electrochemical reaction if the oxidation of such materials is limited. The characteristic potentials and faradaic capabilities of such electrodes were also determined by chronoamperometric and chronopentiometric methods. 2 figures.

3332 BATTERY PLATE GRID. Smith, C.H.; Dunning, K.G. US Patent 4,004,945. 25 Jan 1977. Filed date 6 Feb 1976. 4p.

This invention relates to a battery plate grid of the type that are cast from lead and which have a perimeter frame and a lattice network of bars formed integrally with the frame. The plate grid has protuberances spaced apart on one side only of the lattice network and formed integrally with it. The perimeter frame has a greater thickness than the lattice network, and the principal plane of the lattice network is between the spaced-apart planes of opposed face surfaces of the perimeter frame. The protuberances on one side of the lattice network have a height of about one-half the difference in thickness between the lattice network and the perimeter frame so that the outer extremities of the protuberances are in the plane of one face of the frame and serve to rigidify the lattice network during application of the paste. The tips of the protuberances show only at the surface of the paste when the grid is pasted, so that there is provided a thin construction that has relatively little lead surface exposed at the surface of the paste. 4 figures.

3333 RECHARGEABLE ELECTROCHEMICAL CELL. Boter, P.A. (to U.S. Philips Corp.). US Patent 4,004,943. 25 Jan 1977. Priority date 19 Aug 1974, Netherlands. 2p.

A rechargeable electrochemical cell has an electrode which consists of a lanthanum nickel compound. A counterelectrode consists of a material which is capable of reversibly taking up and giving off an electron and a proton, such as nickel hydroxide or manganese dioxide. 1 figure.

3334 ELECTRODE STRUCTURE FOR ELECTRICAL ENERGY STORAGE DEVICE. Hall, J.C. (to Rockwell International Corp.). US Patent 4,003,753. 18 Jan 1977. Filed date 15 Mar 1976. 14p.

A rechargeable electric energy storage device includes a negative electrode, a positive electrode, and an electrolyte. At least one electrode includes a plurality of wall members, forming a plurality of cells having a certain open cross-sectional area. A substantially planar electrolyte-permeable member is affixed to the wall members and covers the open end of the cells, and a body of electrochemically active material is in the cells. The active material is a solid at the operating temperature of the device, and is retained in the cells of the wall members by the electrolyte-permeable member. 7 figures.

3335 EXPLOSION-PROOF VENT BARREL FOR A BATTERY. Hakarine, D.D. (to Gould Inc.). US Patent 4,002,495. 11 Jan 1977. Filed date 12 Feb 1976. 10p.

An explosion-proof vent barrel has a tubular body, an electrolyte splash baffle, and an electrolyte drain funnel molded integrally with one another, there being a porous flame-arresting disc telescoped into the body. Three barrels are ganged on a common frame which protects the flame-arresting discs against dirt and grease. In one embodiment, the underside surface of the frame is formed with a shallow channel to permit positive venting of the gases which diffuse through the arrestor discs. In another embodiment, both the discs and barrels are maintained in closely spaced relation to the underside of the frame for defining a positive escape area about substantially the entire periphery of the disc. In each instance, the depth of the positive vent escape area does not exceed 0.015 inches, so as to permit positive venting while retarding the entrance of a flame into the space between the disc and frame. 6 figures.

3336 CATALYTIC DEVICE FOR STORAGE BATTERY. Nitta, H.; Watanabe, M. (to Japan Storage Battery Co. Ltd.). US Patent 4,002,496. 11 Jan 1977. Filed date 19 Dec 1974. 6p.

A catalytic device for a battery contains an aqueous electrolyte into which oxygen and hydrogen gases (generated as a result of the electrolysis of the aqueous electrolyte) pass and are catalytically recombined into water, which returns to the electrolyte. The device includes the following components: a catalyst body; a gas-permeable catalyst vessel having the catalyst body arranged therein; a condenser vessel housing the catalyst vessel, the condenser vessel having an opening only at its lower portion; an outer vessel of the catalytic device housing the condenser vessel; and a conduit or passageway for passing a gas from the condenser vessel through a gap between the condenser vessel and the outer vessel. 8 figures.

3337 SECONDARY BATTERY OR CELL. Gupta, N.K.; Ludwig, F.A. (to Ford Motor Co.). US Patent 4,002,806. 11 Jan 1977. Filed date 20 Aug 1975. 14p.

This invention concerns an improved secondary battery or cell of the type having one or more anodic reaction zones containing a molten alkali metal reactant-anode in electrical contact with an external circuit, one or more cathodic reaction zones, and a cation-permeable barrier to mass liquid transport interposed between and in contact with the anodic and cathodic reaction zones. The cathodic reation zone(s) contains a cathodic reactant and an electrode of porous conductive material which is at least partially immersed in the cathodic reactant. When the battery or cell is in the theoretically fully charged state, the cathodic reactant consists of sulfur; when it is at least partially discharged, the reactant consists of a single-phase composition comprising a molten polysulfide salt of the anodic reactant or a two-phase composition comprising molten sulfur and molten sulfur-saturated polysulfide salts of the anodic reactant. The above-mentioned porous, conductive material is in electrical contact with both the cation-permeable barrier and an external circuit. The improvement comprises increasing the charge/discharge capacity of the battery or cell by including in

the cathodic reactant controlled amounts of certain metals, alloys comprising such metals, salts of these metals, and oxides of these metals. 4 figures, 1 table.

3338 ALKALI METAL, SULFUR BATTERY OR CELL WITH SINGLE PHASE SULFUR ELECTRODE. Ludwig, F.A. (to Ford Motor Co.). US Patent 4,002,807. 11 Jan 1977. Filed date 30 Sep 1975. 10p.

This invention concerns an improved secondary battery or cell of the type having one or more anodic reaction zones containing a molten alkali metal reactant-anode in electrical contact with an external circuit, one or more cathodic reaction zones, and a cation-permeable barrier to mass liquid transport interposed between and in contact with the anodic and cathodic reaction zones. The cathodic reaction zone(s) contains a cathodic reactant and an electrode of porous conductive material which is at least partially immersed in the cathodic reactant. When the battery or cell is in the theoretically fully charged state, the cathodic reactant consists of sulfur; when it is at least partially discharged, the reactant consists of a composition comprising a molten polysulfide salt of the anodic reactant or a composition comprising molten sulfur and molten sulfur-saturated polysulfide salts of the anodic reactant. The above-mentioned porous, conductive material is in electrical contact with both the cation-permeable barrier and an external circuit. The improvement comprises increasing the charge/discharge capacity of the battery or cell by dissolving in the cathodic reactant an additive which comprises either an element which will react with molten sulfur to form a polysulfide salt which is soluble in and forms a liquid solution with both sulfur and alkali metal polysulfide salts or a polysulfide salt of the element which is soluble in and forms a liquid solution with both sulfur and alkali metal polysulfide salts. 1 figure.

3339 ELECTROCHEMICAL CELL. Fafa, J. (to Compagnie Industrielle des Piles Electriques Cipel). US Patent 4,002,808. 11 Jan 1977. Priority date 26 Feb 1974, France. 6p.

The invention relates to electrochemical cells intended to be electrically connected in series. Such a connection is obtained by means of a mechanical link between the terminals of opposite polarities of two adjacent cells. That mechanical link may be formed by a spring-catch system, screwing, or locking. The invention applies more particularly to cylindrical electric cells.

3340 IONIC CONDUCTIVITY OF SOLID AND LIQUID LIALCL$_4$. Weppner, W.; Huggins, R.A. (Stanford Univ., CA). J. Electrochem. Soc.; 124: No. 1, 35-38(Jan 1977).

The electrical conductivity of lithium chloroaluminate was investigated in the temperature range between room temperature and 180°C. It is molten above 145°C. The conduction is practically purely ionic and is attributed to the transport of lithium ions. The experiments show high values for ionic conductivity in the solid state, only exceeded by Li--β-alumina and some LiI-based materials. At 25°C the conductivity was found to be 1 x $10^{-6}$ $\Omega^{-1}$ $cm^{-1}$, with an activation enthalpy for sigmaT of 0.47 eV. A-c conductivity measurements were influenced by sample preparation and cell arrangement. The ionic conductivities of this and several other newly found lithium ionic conductors, as well as those previously known, are compared in the temperature range between 20° and 250°C. 3 figures.

3341 ACTIVITY COEFFICIENTS OF DILUTE SOLUTIONS OF LITHIUM IN LIQUID ALUMINUM--TIN ALLOYS: ELECTROMOTIVE FORCE MEASUREMENTS AND INTERPRETATION. Saboungi, M.L.; Blander, M. (Argonne National Lab., IL). J. Electrochem. Soc.; 124: No. 1, 6-13(Jan 1977).

The activity coefficients of Li solutions dilute in the binary alloy Al--Sn were determined from emf measurements. At T = 949°K, dilute solutions of Li in pure liquid Al and in pure liquid Sn follow the Nernst law. The data provide an independent and accurate evaluation of the limiting excess chemical potentials of Li in Al and in Sn, μ/sup xs/Li(Al) = -2.54 kcal $mol^{-1}$ (or -10.63 kJ $mol^{-1}$), and μ/sup xs/Li(Sn) = -12.22 kcal $mol^{-1}$ (or -51.14 kJ $mol^{-1}$), respectively. Variations of the Li activity coefficients with the solvent composition are discussed, and various models for the interpretation of dilute solution activity data are reviewed. A refinement of the quasi-lattice theory is suggested where ΔA/sub i/, the specific ''bond'' free energy corresponding to the changes in interactions in the equilibria for forming the LiAl/sub (Z-i)/Sn/sub i/ species becomes a function of composition and of i. This new approximation for ΔA/sub i/ is shown to give a better representation of the data than previous approximations. 3 figures, 2 tables

3342 ELECTROCHEMICAL STUDIES OF MASS TRANSPORT IN HIGH TEMPERATURE ELECTROLYTES. Vallet, C.E. (Univ., Marseille); Braunstein, J. J. Electrochem. Soc.; 124: No. 1, 78-83(Jan 1977).

Chronopotentiometry with electromigrational depletion (ED) is applied to the evaluation of interdiffusion coefficients in the binary molten salt mixtures 53-47, 65-35, and 70-30 $BeF_2$-LiF. The effect of composition dependence on the measured values of the diffusion coefficients is discussed for these mixtures and for $AlCl_3$--NaCl mixtures. The method of analysis of the chronopotentiograms is applicable also to the evaluation of mass transfer polarization in high temperature battery electrolytes.

3343 OXYGEN EVOLUTION ON SEMICONDUCTING OXIDES. Tseung, A.C.C.; Jasem, S. (City Univ., London). Electrochim. Acta; 22: No. 1, 31-34(Jan 1977).

The oxygen evolution reaction is of particular interest to secondary metal--air batteries and water electrolysis plants. However, most of the earlier work has been on precious metals, and there are no guidelines for the choice of semiconducting oxides as oxygen-evolving electrodes. In this study, the role of the metal/metal oxide or the lower metal oxide/higher metal oxide couple in determining the minimum voltage required for the evolution of oxygen is emphasized, together with other essential requirements such as electrical resistivity, electrode microstructure, corrosion resistance, and catalytic properties. A survey of various metal oxides based on the above criterion suggested that $NiCo_2O_4$ is of particular interest, and Teflon-bonded electrodes based on this material gave over 13,000 A/$m^2$ at 1.63 V vs dhe, 70°C, 5 N KOH. 6 figures, 1 table.

3344 EFFECT OF ADDITIVES ON LITHIUM CYCLING IN PROPYLENE CARBONATE. Rauh, R.D.; Brummer, S.B. (EIC Corp., Newton, MA). Electrochim.

Acta; 22: No. 1, 75-83(Jan 1977).
Deposition and discharge of lithium on an inert (nickel) substrate in 1 M $LiClO_4$/ propylene carbonate (PC) was studied as a function of plating and stripping currents, cycle number, and electrolyte composition. Water (less than 0.06 M), nitromethane, and $SO_2$ were found to enhance the cycling efficiency, which was relatively low in the dry electrolyte without additives. In all cases, marked deterioration in efficiency was noted after 10 to 20 repeated cycles. Electro-deposited lithium became unavailable for electrochemical stripping initially (over the first 10,000 s of its life) at an average rate of 30 to 40 μA/ $cm^2$, essentially independent of the additive. This rate of capacity loss decreases with time, and reaches a limiting value of 5 to 10 $\mu A/cm^2$. This rate is also not improved by presence of additives. A mechanism of loss of efficiency during lithium cycling and also on open circuit stand was formulated: granules of lithium are encapsulated by an insulating film of PC--lithium reaction products; electrical contact with the substrate is thus severed. The additives are postulated to form $Li^+$-conductive films on the deposit, and thus allow deposition onto the granules and their growth into larger granules. On open circuit stand, the long-term equilibrium favors the formation of an insoluble insulating (Li--PC) film over the $Li^+$-conductive film. It is suggested that such behavior limits the usefulness of propylene carbonate in secondary lithium batteries. 9 figures, 2 tables.

3345 EFFECT OF ADDITIVES ON LITHIUM CYCLING IN METHYL ACETATE. Rauh, R.D.; Brummer, S.B. (EIC Corp., Newton, MA). Electrochim. Acta; 22: No. 1, 85-91(Jan 1977).
Methyl acetate (MA) was examined as a solvent for use in nonaqueous secondary lithium batteries. The efficiency of cycling lithium on nickel in MA/1 M $LiClO_4$ containing less than 10 ppM $H_2O$ was less than 10 percent. Addition of nitromethane (NM), $SO_2$ or small amounts of $H_2O$ improved the efficiency markedly. Compared to propylene carbonate (PC), MA plus $SO_2$ or NM afforded more repeated cycles before failure of the working electrode. Unlike PC, the open-circuit lithium disappearance rate in MA is decreased in the presence of additives, e.g., from about 300 $\mu A/cm^2$--70 $\mu A/cm^2$ with greater than 0.2 M nitromethane, and to essentially 0 $\mu A/cm^2$, under the proper conditions, with 3 M $SO_2$. The differences in behavior between PC and MA are attributed to the greater solubility of the MA--lithium reaction products, allowing greater opportunity for buildup of additive-induced conductive films on the metallic deposit. 11 figures.

3346 BATTERY PLATE CONNECTION IN SLI BATTERIES. Howard, A.M. Warrendale, PA; Society of Automotive Engineers (1977). 7p. (CONF-770205--31).
From Conference of the SAE International Automotive Engineering Congress and Exposition; Detroit, Michigan, USA (28 Feb 1977).
The evolution of plate burning and cell interconnection of SLI batteries is followed from the older antimony--lead batteries to the newer maintenance-free batteries. The criteria for top lead selection for both types of batteries are compared. A new accelerated test for component evaluation is described and the laboratory results are discussed. 10 figures, 2 tables.

3347 STUDIES OF MORE RAPID ELECTROFORMING OF LEAD STORAGE BATTERY PLATES WITH CURRENT WHICH CHANGES POLARITY. Penchev, P.; Gishin, S. Elektrotekhnika; No. 2, 45-46(1977). (In Russian).
A method was developed for electroforming lead storage battery plates with direct current of periodically varying polarity. Current pulse length in the forward direction is 3 min and, in the reverse, 25 s. Varying the polarity of the current leads to a reduction of the internal resistance of storage battery plates, and thus creates good conditions for homogeneous electroforming of the active mass, which then exhibits better mechanical properties, and results in a reduction in consumption of the electrical energy required for forming the plates. Studies demonstrated that varying the polarity of the forming current leads to considerable reduction of the time for the electrochemical process and to an increase in the beta modification of $PbO_2$. The new method was tested using a commercial unit. In forming plates by the new method, current density increased by a factor of 3.48 and the time for forming plates was reduced by a factor of 3.6. X-ray crystallographic analysis of positive plates showed the content of beta-$PbO_2$ to be 68 to 89 percent with the new method, as opposed to 38 to 48 percent in control tests. There was thus an increase in the yield of the modification with the higher energy capacity. Rejects were reduced from 5.9 to 12.7 percent to 0.43 to 2.3 percent with the new method. Plates were also tested for charging time, rated capacity, and service life. Service life tests showed that plates formed by the new method last 25 percent longer. The advantages of the new method are as follows: The process of electroforming plates is shortened by approximately 70 percent; a 15 to 20 percent savings of electrical energy is realized; the energy parameters of storage batteries are improved considerably; and the performance rating of storage batteries are higher. 3 tables.

3348 CONTROL OF ADHESION IN ANODE MASS CONSISTING OF PETROLEUM COKE. Ishkil'din, A.F.; Voloshin, N.D.; Syunyaev, Z.I. (Ufa Pet Inst, USSR). Izv. Vyssh. Uchebn. Zaved., Neft Gaz; No. 1, 47-50(1977). (In Russian).
Results of measurement of the adhesion of various types of pitch, serving as binders for coke grades used as anodic mass fillers are presented. The possibility of controlling the intensity of the adhesive contact of phases in this system of changing the ratio between group components in pitch, the temperature of coke calcination, and conditions of mixing pitch with coke, is established.

3349 ELECTRODE FOR ALKALINE STORAGE BATTERY AND METHOD FOR MANUFACTURE THEREOF. Takahashi, S.; Miyake, Y. (to Agency of Industrial Science and Tech.). US Patent 4,000,004. 28 Dec 1976. Priority date 23 Oct 1972, Japan. 6p.
An anode for use in the alkaline storage battery, which anode comprises an iron electrode incorporating a permanent magnet, is described. 5 figures.

3350 STORAGE BATTERY CHARGING SYSTEM WITH ALTERNATOR OUTPUT FAULT INDICATING CIRCUIT. Sheldrake, L.J.; Ruff, D.O.; King, C.W. (to General Motors Corp.). US Patent 4,000,453. 28 Dec 1976. Filed date 17 Dec 1975. 12p.
A circuit is disclosed for indicating faults in a storage battery charging system of the type including a voltage regulator-controlled alternator field winding switching transistor and a rectifier circuit having a diode trio

which supplies alternator field winding energizing current. A differential amplifier circuit, to which is applied normally equal reference and sensing potentials which become unbalanced with alternator faults, produces a first fault-indicating signal in the event of an alternator malfunction. A transistor having the control electrode connected to the output of the field winding diode trio of the rectifier circuit produces a second fault-indicating signal in the event of a failure of one of these diodes. These fault-indicating signals trigger a transistor conductive to complete an energizing circuit for a fault-indicating device. Additionally, an oscillator flashes the fault-indicating device ''on'' and ''off'' in the event of a voltage regulator failure. 1 figure.

3351 BREAKER SWITCH FOR AUTO BATTERY. Carter, E.L.; Spector, G. US Patent 4,000,388. 28 Dec 1976. Filed date 23 Dec 1974. 2p.

An accessory mountable within an automotive vehicle prevents the vehicle from catching on fire in case any wiring becomes shorted. The accessory consists of a block mountable anywhere in the engine compartment, the block supporting terminals connected to the battery and to the ground. One terminal has a pivotable throw arm contacting the other terminal. The battery entire electric output is passed through the accessory so that, if the throw arm is pivoted away to break the contact between the accessory terminals, the electric system of the vehicle is off.

3352 BATTERY SEPARATOR. Hollenbeck, B.; Stockett, A.L.; Tate, J.L.; Simmons, D.M. (to W. R. Grace and Co.). US Patent 4,000,352. 28 Dec 1976. Filed date 1 Jun 1972. 10p.

A battery separator is provided that has a plurality of protrusions extending above its main surface. The protrusions are arranged in an entirely new pattern which permits a minimum total area of the separator to be covered with protrusions and yet assures good contact with all areas of a battery's grid. The protrusions are placed in alternating rows in a manner blocking any openings between protrusions with which an element of the battery's grid could be registered. Another aspect includes a compressible battery separator having compressible embossments. 6 figures.

3353 METHOD FOR MAKING A NICKEL POSITIVE ELECTRODE FOR AN ALKALINE BATTERY. McBreen, J. (to General Motors Corp.). US Patent 4,000,005. 28 Dec 1976. Filed date 8 Jan 1976. 8p.

A nickel alkaline storage battery electrode can be made by vacuum impregnating a porous conductive support with a coagulum of nickel hydroxide, cobalt hydroxide and graphite particles entrained in a three-dimensional, reticulated, open-celled polyvinylidene fluoride binder, and thereafter compressing and drying the impregnated support. The coagulum is formed by mechanically suspending the hydroxide and graphite particles in a medium which is not a solvent for the polyvinylidene fluoride. In a separate operation the polyvinylidene fluoride is dissolved in a solvent which is only slowly soluble in the suspension medium for the particles. Then the polyvinylidene fluoride solution is added to, and intimately mixed with, the suspension in such a way that the polyvinylidene fluoride slowly precipitates and coagulates substantially uniformly throughout the solution--suspension mixture and entrains the particles therein as coagulation proceeds.

3354 CALCIUM ALLOY AS ACTIVE MATERIAL IN SECONDARY ELECTROCHEMICAL CELL. Roche, M.F.; Preto, S.K.; Martin, A.E. (to Energy Research and Development Administration). US Patent 3,980,495. 14 Dec 1976. Filed date 19 Dec 1975. 8p.

PAT-APPL-642,438.

Calcium alloys, such as calcium--aluminum and calcium--silicon, are employed as active material within a rechargeable negative electrode of an electrochemical cell. Such cells can use a molten salt electrolyte including calcium ions and a positive electrode having sulfur, sulfides, or oxides as active material. The calcium alloy is selected to prevent formation of molten calcium alloys resulting from reaction with the selected molten electrolytic salt at the cell operating temperatures. 1 table.

3355 BATTERY HAVING POLYAMIDE HOT MELT ADHESIVE SEAL. Feldhake, R.H. (to ESB Inc.). US Patent 3,997,365. 14 Dec 1976. Filed date 10 Dec 1973. 8p.

A battery has a peripheral seal which surrounds the electrodes. The seal comprises a plurality of layers adhered together, one of which layers is metal and another one of which is plastic. The seal is produced between the metal and plastic layers. The seal uses a hot melt adhesive containing substantial amounts of polyamide having a viscosity of from about 1 poise to about 100 poise at 350°F. 8 figures, 1 table.

3356 THERMODYNAMIC PROPERTIES OF THE LITHIUM--SILICON SYSTEM. Sharma, R.A.; Seefurth, R.N. (General Motors Corp., Warren, MI). J. Electrochem. Soc.; 123: No. 12, 1763-1768(Dec 1976).

The feasibility of using silicon as an alloying agent for the negative electrode in Li/$FeS_2$ cells was determined by studying cells of the type Li (liq) or 40 a/o Li--Al alloy (sol)/LiCl--KCl eutectic or LiF--LiCl--LiBr melts/Li (in solid Li--Si alloys at equilibrium). The Li--Si electrode was found reversible with respect to lithium between 650° and 725°K. The nonstoichiometric ranges of the respective Li--Si compounds and electromotive forces (emf's) in the two-phase regions of the Li--Si phase diagram between 650° and 750°K were measured. These studies indicated a new compound, $Li_{21}Si_8$, which was confirmed by x-ray diffraction, scanning electron microscope, and differential thermal analysis. The activities and relative partial molar properties of lithium and silicon in the two-phase regions of the phase diagram were calculated from the emf's in the temperature range 650° to 750°K, and the standard free energy of formation for the compounds, $Li_2Si$, $Li_{21}Si_8$, $Li_{15}Si_4$, and $Li_{22}Si_5$, were also determined. 9 figures, 4 tables.

3357 MICROSTRUCTURAL ASPECTS OF GRID CORROSION IN THE $PBO_2$ ELECTRODE. Marshall, D.; Tiedemann, W. (Globe--Union, Inc., Milwaukee). J. Electrochem. Soc.; 123: No. 12, 1849-1855(Dec 1976).

A radical change in microstructure was examined for its effect on the mode of corrosive attack and corrosion rate for a 5 weight percent antimonial lead alloy. Metallography on as-cast microstructures indicates a transition from interdendritic to general attack with increasing overpotential. The potential region for general attack corresponds to a breakdown in the passivating

abilities of $PbO_2$, and is marked by a sharp rise in the corrosion current. A simple heat-treatment, which alters the structure of the eutectic material, reduces interdendritic attack over the entire potential region studied. 8 figures, 2 tables.

3358 SOME STUDIES ON SODIUM/SULFUR CELLS. Bauer, R.; Haar, W.; Kleinschmager, H.; Weddigen, G.; Fischer, W. (Brown, Boveri and Cie AG, Heidelberg). J. Power Sources; 1: No. 2, 109-126(Dec 1976).

Some results concerning the evaluation and improvement of the properties of sodium/sulfur cells are reported. The magnesia-doped sodium beta alumina used as an electrolyte in this type of cell has a high conductivity and long life. Current collector and container materials with a high corrosion resistance to the $Na_2S_4$ melt were found. Several hundred charge--discharge cycles were obtained with laboratory cells. High rechargeabilities could be achieved in special cells. Finally, it is shown that the technical and economical prospects for traction and load-leveling sodium/sulfur batteries are promising. 10 figures, 4 tables.

3359 PROGRESS OF THE DISCHARGE REACTION OF POSITIVE ACTIVE MASSES OF THE LEAD--ACID STORAGE BATTERY. Reinhardt, P.; Vogt, M.; Wiesener, K. (Technische Univ., Dresden). J. Power Sources; 1: No. 2, 127-139(Dec 1976). (In German).

With the progressive discharge of porous lead dioxide electrodes, the $PbO_2$ content decreases and that of $PbSO_4$ increases correspondingly. If alpha and beta $PbO_2$ are present side by side, then at low current densities and 45°C they share in the discharge reaction to the same extent. With increasing current density and at lower temperatures, a preferential reaction of the beta $PbO_2$ is observed. All pore areas of the porous electrode become gradually overgrown with lead sulfate during the discharge. If a positive active mass, rich in beta $PbO_2$, has a high proportion of fine pores, these become blocked up relatively quickly with lead sulfate; for an active mass with coarse pores, only a constriction of the pores occurs. There is a decrease in the specific surface of porous lead dioxide electrodes, as a result of the deposition of lead sulfate of small surface area, during the discharge reaction. Discharge temperature and current density influence the size of the lead sulfate crystals, the degree of electrode surface coverage with lead sulfate, the discharged structure, and hence also the capacity of the electrode. 7 figures, 1 table.

3360 STUDIES ON THE ALKALI METAL ALLOY-CHLORINE SECONDARY BATTERY. Matsunaga, M. (Kyoto Univ.); Ito, Y.; Yoshizawa, S. J. Power Sources; 1: No. 2, 159-167(Dec 1976).

This paper is concerned with an alkali metal--chlorine secondary battery for a load levelling device, and especially with the negative electrode. An alkali metal alloy is a promising negative electrode material for a high-performance battery. The energy density and power density of such alloy electrodes can be discussed in relation to the phase diagram. A liquid alloy is preferable when long cycle life is required, and a solid alloy is preferable from the cell design aspect. Experimental data and theoretical considerations to support such conclusions are given. 10 figures, 2 tables.

3361 EFFECTS OF DISCHARGES ON POSITIVE PLATES IN LEAD BATTERIES. Reinhardt, P.; Vogt, M.; Wiesener, K. (Tech Univ, Dresden, Ger). J. Power Sources; 1: No. 2, 127-139(Dec 1976). (In German).

Results of a study are reported about the effects of discharges and porous lead dioxide electrodes. If alpha and beta $Pb_2$ are present side by side, then at low current densities and 45°C they share in the discharge reaction to the same extent. With increasing current density and at lower temperatures, a preferential reaction of the beta $PbO_2$ is observed. All pore areas of the porous electrode become gradually overgrown with lead sulphate during the discharge. There is a decrease in the specific surface of porous lead dioxide electrodes, as a result of the deposition of lead sulphate of small surface area, during the discharge reaction. Discharge temperature and current density influence the size of the lead sulphate crystals, the degree of electrode surface coverage with lead sulphate, the discharged structure, and hence also the capacity of the electrode.

3362 LITHIUM CELLS BASED ON SILVER SALTS AS CATHODES. Conte, S.; Filippeschi, V.; Pistoia, G. (Univ di Roma, Italy). J. Power Sources; 1: No. 2, 193-201(Dec 1976).

The performances of button-type lithium cells based on $Ag_2CrO_4$, $Ag_3PO_4$, and $AgIO_3$ as cathodes have been evaluated in different electrolytes. It was found that each silver salt is influenced in a different way by the change of the electrolyte. When using solutions containing $LiAlCl_4$, a silver complex is formed which affects the discharge behavior and the storage life. Indications of the discharge processes have been obtained by determining the coefficients of utilization at low discharge rates and by X-ray analysis.

3363 AUTOMOTIVE BATTERY VOLTAGE INDICATOR FOR 12 VOLTS. Boyce, P.H. Electron. Eng.; 48: No. 586, 29(Dec 1976).

An indication of battery voltage is useful to the motorist in many ways, such as monitoring the battery's capacity to deliver current and as a check on the efficiency of the dynamo and regulator. A circuit is described which is a solid state alternative to a moving coil meter. The output uses three different color LEDs to give an indication of the battery voltage over the critical range 10 to 14 v. The circuit can be easily modified for different voltages or it can be extended.

3364 VENT VALVE FOR NICKEL--CADMIUM ENERGY CELLS. Decker, A.S.; Stephenson, R.F. (to Motorola, Inc.). US Patent 3,994,749. 30 Nov 1976. Filed date 21 Aug 1975. 4p.

A vent valve for electric energy cells requiring pressure relief capability for gases formed within the cells due to overcharging or other circumstances includes a cover plate for the internal structure of the cell which contains a central relief aperture. A vent cap is affixed to the cover plate with one or more vent ports being provided. A resilient seal is provided between the vent cap and the cover plate for controlling the release of the gases, the seal being die-cut of a suitable corrosion-resistant material and having two parallel plane surfaces which contact the cover plate and the closed end of the vent cap when the cap and plate are joined. The seal is preferably of a polygon configuration and its vertices contact the walls of the cap for fixed positioning. The vent path for the gases is through the aperture in the cover plate,

between the cover plate and the resilient seal, and out through the vent ports. 3 figures.

3365 SECONDARY BATTERY OR CELL WITH COMPOSITE ELECTRODE. Ludwig, F.A. (to Ford Motor Co.). US Patent 3,993,503. 23 Nov 1976. Filed date 30 Jan 1976. 16p.

An improved secondary battery or cell has one or more anodic reaction zones containing a molten alkali metal reactant-anode in electrical contact with an external circuit; one or more cathodic reaction zones; and a cation-permeable barrier to mass liquid transfer interposed between and in contact with the anodic and cathodic reaction zones. The cathodic reaction zone(s) contains a cathodic reactant and an electrode which is at least partially filled with the cathodic reactant. The electrode is in electrical contact with both the cation-permeable barrier and an external circuit. When the battery or cell is at least partially discharged, the above-mentioned cathodic reactant consists of either a single-phase composition comprising molten polysulfide salts of the anodic reactant or a two-phase composition comprising molten sulfur and molten sulfur-saturated polysulfide salts of the anodic reactant. The improvement comprises a composite electrode comprising at least one first portion of porous conductive material which is more readily wet by molten polysulfide than by molten sulfur and at least one second portion of porous conductive material which is more readily wet by molten sulfur than by molten polysulfide. 6 figures.

3366 METALLIC SULFIDE ADDITIVES FOR POSITIVE ELECTRODE MATERIAL WITHIN A SECONDARY ELECTROCHEMICAL CELL. Walsh, W.J.; McPheeters, C.C.; Yao, N.P.; Koura, K. (to Energy Research and Development Administration). US Patent 3,992,222. 16 Nov 1976. Filed date 15 Jul 1975. 10p. PAT-APPL-596,044.

An improved active material for use within the positive electrode of a secondary electrochemical cell includes a mixture of iron disulfide and a sulfide of a polyvalent metal. Various metal sulfides, particularly sulfides of cobalt, nickel, copper, cerium and manganese, are added in minor weight proportion in respect to iron disulfide for improving the electrode performance and reducing current collector requirements. 5 fig., 4 tables.

3367 SEPARATORS FOR A STORAGE BATTERY. Ito, T.; Matsui, H. US Patent 3,989,545. 2 Nov 1976. Priority date 11 Apr 1974, Japan. 8p.

Separators for a lead-acid storage battery are provided which are composed of a fibrous structure such as non-woven fabric, paper, woven or knitted fabric which is impregnated with 1 to 50 percent by weight, based on the weight of the fibrous structure not yet coagulated, of an organopolysiloxane and then cured. 5 tables.

3368 BATTERY GRID. Grabb, N.G. (to Varta Batteries Ltd.). US Patent 3,989,539. 2 Nov 1976. Filed date 1 Dec 1975. 6p.

An improved rectangular shaped lead--acid storage battery grid comprises in combination tapered vertical grid wires, tapered side and top frame wires, additional vertical grid wires disposed between the tapered vertical grid wires, and two diagonal grid wires which extend from the grid portion containing the additional grid wires to the side and bottom frame wires. Not all the vertical grid wires are tapered. The last of the tapered vertical grid wires is spaced from the side frame wire adjacent the lug, a distance of more than approximately 30 percent and up to approximately 50 percent of the entire length of the top frame wire. The additional vertical grid wires extend downwardly from the top frame wire a distance of approximately 30 to 50 percent of the length of the side frame wire. A battery cell made up of this type of grid has approximately 5 to 10 percent increased high amperage discharge rate compared to a battery having a standard type of grid. The grid also has increased structural rigidity compared to standard battery grids.

3369 EFFECT OF AN INDUSTRIAL EXPANDER ON THE DISCHARGE PROCESS OF A LEAD MICROELECTRODE IN 4.5 M SULFURIC ACID. Le Mehaute, A. (Laboratoire de Marcoussis, France). J. Appl. Electrochem.; 6: No. 6, 543-550(Nov 1976).

The presence or absence of an industrial expander is shown to produce a difference in the discharge of a lead microelectrode in concentrated sulphuric acid. The expander acts both before and after passivation, and modifies the concentration and relaxation time of Pb(II) soluble reaction intermediates. 10 figures.

3370 SEM STUDIES OF DISCHARGE PRODUCTS FROM ALKALINE IRON ELECTRODES. Oejefors, L. (Royal Inst. of Tech., Stockholm). J. Electrochem. Soc.; 123: No. 11, 1691-1696(Nov 1976).

Anodic oxidation products in 5N KOH of both planar and porous iron electrodes were investigated with SEM techniques. On the first discharge level well-defined crystallites of $Fe(OH)_2$ are formed, while on continued discharge the products become sludge formed, probably consisting of hydrated FeOOH. The morphologies support the dissolution--precipitation mechanism during the first discharge step. The second anodic level proceeds probably via migration of ions and electrons in the solid phase. The crystallite size increases with temperature which depends on the fact that the relative supersaturation decreases. (7 figures, 1 table)

3371 PERFORMANCE CHARACTERISTICS OF SOLID LITHIUM--ALUMINUM ALLOY ELECTRODES. Gay, E.C.; Vissers, D.R.; Martino, F.J.; Anderson, K.E. (Argonne National Lab., IL). J. Electrochem. Soc.; 123: No. 11, 1591-1596(Nov 1976).

Lithium--aluminum alloy electrodes have shown a great deal of promise for meeting the performance requirements of negative electrodes in batteries for off-peak energy storage in utility networks and for vehicle propulsion. To develop negative electrodes that meet the cell performance goals, the effects of a number of variables on the lithium--aluminum electrode performance were determined. Investigations were conducted to determine the effects of volume fraction electrolyte in the electrode, electrode thickness, fabrication technique, lithium concentration in the Li--Al alloy, and current collector in the electrode. Electrochemically formed Li--Al electrodes that are 0.32 cm thick, have an electrolyte volume fraction of 0.2 in the charged state, and contain about 2 percent stainless steel wire current collector demonstrated the performance goals for the negative electrodes in a Li--Al/$FeS_2$ electric automobile battery. For electrode thicknesses greater than or equal to 0.64 cm, vibratorily loaded pyrometallurgical Li--Al electrodes with porous metallic current collectors demonstrated the highest lithium utilization and capacity density over a wide range of discharge current densities and met the performance goals for negative electrodes

in a Li--Al/$FeS_2$ off-peak energy storage battery. (8 figures, 3 tables)

3372 ENGINEERING ANALYSIS OF SHAPE CHANGE IN ZINC SECONDARY ELECTRODES. I. THEORETICAL. Choi, K.W. (Univ. of California, Los Angeles); Bennion, D.N.; Newman, J. J. Electrochem. Soc.; 123: No. 11, 1616-1627(Nov 1976).

Shape change, the redistribution of active material over the zinc electrode surface as a result of cell cycling, is hypothesized to be caused by convective flows driven primarily by membrane pumping. A mathematical model is formulated based on the convective flow hypothesis for the zinc--silver oxide secondary cell. The numerical solutions predict redistribution of zinc material over the zinc electrode, fluid flow rates, and variations of current distribution and cell potential with the number of cycles. These calculated results can be compared to experimental results. The results suggest that shape change can be eliminated if the convective flow in the zinc electrode compartment parallel to the electrode surface is stopped. (11 figs.)

3373 ENGINEERING ANALYSIS OF SHAPE CHANGE IN ZINC SECONDARY ELECTRODES. II. EXPERIMENTAL. Choi, K.W. (Univ. of California, Los Angeles); Hamby, D.; Bennion, D.N.; Newman, J. J. Electrochem. Soc.; 123: No. 11, 1628-1637(Nov 1976).

Experimental data on zinc--silver oxide secondary cells were used to evaluate the convective flow hypothesis on the cause of shape change of zinc electrodes. A cell with flooded, vented electrodes designed to allow "normal" convective flow was studied. Zinc electrodes cycled in this cell showed extensive material redistribution in accord with predictions based on the hypothesis. Measured volume average fluid flow rates for this cell were also in agreement with predicted values. Zinc electrodes cycled in a second cell, designed to minimize convective flow in the zinc electrode compartment, showed virtually no active material redistribution. (8 figures)

3374 DISTRIBUTION OF CURRENT DENSITY ON ELECTRODES OF SILVER--ZINC STORAGE BATTERY DURING DISCHARGE. Bayunov, V.V.; Dasoyan, M.A. Elektrotekhnika; No. 11, 31-32(Nov 1976). (In Russian).

The distribution of current density on the electrodes as well as the distribution of the capacitance (taken from the surface lengthwise of the electrodes) in a silver--zinc storage battery during the process of various conditions of discharge is investigated. It is found that in a silver--zinc storage battery one of the factors which accompanies a more uniform distribution of the capacitance taken lengthwise of the electrodes, as compared with a lead storage battery, is the presence of two plateaus on the voltage potential curve during discharge and the large difference of the potentials between them. 3 figures.

3375 METHOD FOR MAKING NICKEL AND CADMIUM ELECTRODES FOR BATTERIES. Stephenson, R.F. (to Motorola, Inc.). US Patent 3,986,893. 19 Oct 1976. Filed date 28 Nov 1975. 6p.

An improved process for the electrolytic deposition of active material is described. The material may be in the form of a suitable metal hydroxide in a porous sintered nickel plaque, which in turn may be utilized to form the positive and/or negative electrodes of a nickel--cadmium battery. The process is characterized by the use of an organic acid such as formic acid as the buffering or support agent which effectively stabilizes the pH of the impregnating solution at an optimized value, while at the same time it avoids generating any particulate byproduct which would otherwise contaminate the solution; a virtually unlimited service life thereby results. Other advantages to the use of formic acid as the buffering material are disclosed as well.

3376 POROUS COBALT ELECTRODES FOR ALKALINE ACCUMULATORS AND HYBRID CELL THEREWITH AND AIR ELECTRODE. Ewe, H.H.; Justi, E.W. US Patent 3,986,892. 19 Oct 1976. Priority date 15 Dec 1972, German, Federal Republic of (F.R. Germany). 8p.

A porous, preferably negative, electrode for alkaline accumulators is characterized by the fact that its electrochemically active inner surface amounts to between 1 and 20 $m_2$ per gram for a volume porosity of between 30 and 85 percent and that its pore interval ranges between 0.15 and 1.0 μm. 2 figures.

3377 SEAL FOR ENERGY CONVERSION DEVICES. Lingscheit, J.N.; Whalen, T.J. (to Ford Motor Co.). US Patent 3,985,576. 12 Oct 1976. Filed date 18 Feb 1976. 10p.

An improved energy conversion device comprises an anodic reaction zone which contains a molten alkali metal anode-reactant in electrical contact with an external circuit, and which is disposed interiorly of a tubular cation-permeable barrier to mass liquid transfer; a cathodic reaction zone which is disposed exteriorly of the tubular cation-permeable barrier, and which contains an electrode which is in electrical contact with both the tubular cation-permeable barrier and the external circuit; a reservoir for the molten alkali metal which is adapted to supply the anode-reactant to the anodic reaction zone; and a tubular ceramic header which connects the reservoir with the anodic reaction zone so as to allow molten alkali metal to flow from the reservoir to the anodic reaction zone, the header being sealed to the tubular cation-permeable barrier and impervious and nonconductive so as to preclude both ionic and electronic current leakage between the alkali metal reservoir and the cathodic reaction zone. The improvement of the invention comprises a lap joint seal between the tubular ceramic header and the tubular cation-permeable barrier which is formed by (1) disposing the end portion of a first one of the tubes, which has been sintered to final density, inside the end portion of the second of the tubes which is not sintered to final density, has an inner diameter in the unsintered state greater than the outer diameter of the first tube, and upon being sintered to final density is adapted to shrink to the extent that the inner diameter thereof is at least 0.002 inches less than the outer diameter of the first tube, and (2) sintering the second tube to shrink the same and effect a seal between the first and second tubes. 2 figures.

3378 METHOD FOR DETERMINING BATTERY STATE OF CHARGE BY MEASURING A.C. ELECTRICAL PHASE ANGLE CHANGE. Dowgiallo, E.J. Jr. US Patent 3,984,762. 5 Oct 1976. Filed date 7 Mar 1975. 7p.

Several embodiments for determining the state of charge of a cell or battery are disclosed. In accordance with one method of this invention, an ac voltage is applied to a cell or battery through a shunt. The phase angle between the ac voltage across the battery terminals and the ac current through the

battery (measured as a shunt voltage) is continuously monitored. This phase angle is converted to an analog voltage which represents the ac component that is phase shifted by the impedance of the battery.

3379 OXYGEN--AIR GAS-DIFFUSION ELECTRODES OF THE HYDROPHOBIC TYPE MADE OF CARBON AS ELECTROCHEMICAL POWER SOURCES, OPERATING WITH FLUID FUELS OR SOLID FUELS DISPERSED IN THE ELECTROLYTE. Iliev, I.; Gamburtsev, S.; Kaisheva, A.; Budevski, E. (Central Lab. for Electrochemical Power Sources, Sofia). Int. Chem. Eng.; 16: No. 4, 691-694(Oct 1976).
Translated from Izv. Otd. Khim. Nauki, Bulg. Akad. Nauk.; 7: No. 4, 755-761(1974).
Work is described to study and optimize the structure of microporous separators attached to the electrolyte side of this type of electrode, which is suitable for use in alkaline zinc--air fuel cells. The optimum type found achieves high reliability at expense of some electrical loss, which remains in the usual range for zinc--air fuel cell electrodes.

3380 SODIUM SULPHUR CELLS. Jones, I.W.; Robinson, G.; Bird, T.L. (to Electricity Council). US Patent 3,982,957. 28 Sep 1976. Priority date 15 Feb 1974, United Kingdom of Great Britain and Northern Ireland (UK). 10p.
In a sodium--sulfur cell the cathode current collector in the sulfur/polysulfide cathodic reactant comprises a carbon or graphite tube containing a solid metal, e.g. aluminum, core and a liquid metal, e.g. tin or a tin--lead alloy, as a conducting interface between the carbon or graphite tube and the core. In a preferred construction, the current collector is axially located within a cylindrical electrolyte tube, the space between the electrolyte tube and graphite tube containing the sulfur/polysulfides and a graphite felt. The outer surface of the graphite tube in this case may have grooves or recesses to form a sulfur reservoir. 5 figures.

3381 NON-AQUEOUS BATTERY SYSTEM. Newman, G.H. (to Union Carbide Corp.). US Patent 3,982,958. 28 Sep 1976. Filed date 9 May 1974. 8p.
The invention relates to the use in a nonaqueous battery system of an electrolyte comprising a solute dissolved in a solvent of nitrobenzene or a substituted nitrobenzene compound. 3 figures, 1 tables.

3382 GAS DIFFUSION ELECTRODE FOR A BATTERY. Fukuda, M.; Iwaki, T.; Kawano, H. (to Matsushita Electric Industrial Co., Ltd.). US Patent 3,981,749. 21 Sep 1976. Priority date 30 Nov 1966, Japan. 10p.
This specification discloses a gas diffusion electrode for a battery. A layer which is formed of a binding agent and substance such as graphite, nickel oxide, aluminum oxide, or the like (so as to represent no catalytic action with respect to a fuel) is provided on the electrolyte side of a high-porosity sintered member of which the constituent is nickel. In this way a decrease in the electrode potential due to the active fuel and in the utilization rate of such fuel is prevented, while at the same time permeation of a gas supplied to the electrode into the electrolyte and leakage of such electrolyte into the gas are restrained. 3 figures.

3383 MAINTENANCE-FREE LEAD SECONDARY CELL. Voss, E.; Rabenstein, H. (to Varta Batterie AG). German(FRG) Patent 2,509,779/A/. 16 Sep 1976. 7p. (In German).
1 fig. Available from Dt. Patentamt, Muenchen (FRG).
The invention deals with a maintenance-free lead accumulator whose electrode grids consist of fine lead or antimony-free lead alloys and which contains a sulfuric acid electrolyte which is fixed in the pores of the separator and of the active masses. According to the invention one can considerably increase the survival frequency depending on the charge--decharge cycle number, as well as the cycle strength by a) keeping the weight of the negative active masses under 80% of the weight of the positive masses, and measuring the quantity of electrolyte and the electrolyte concentration in such a manner that the acid density has a maximum value of 1.07 g/cm$^3$ after decharging with the 20-hour current, and b) adding phosphoric acid in a quantity of 20 to 40 g/l, preferably a quantity of 30 to 35 g/l, to the electrolyte.

3384 SEPARATORS FOR ALKALINE BATTERIES. Gillman, L.M.; Stark, R.E. (to Gates Rubber Co.). US Patent 3,980,497. 14 Sep 1976. Filed date 3 Aug 1970. 6p.
A multi-layer separator for use in alkaline storage batteries is disclosed. In one aspect of the invention the separator comprises bibulous, nonmembranous layers together with a coating of a relatively thin layer of a gelling agent applied to at least one side of one of the bibulous layers. In another aspect of the invention, outer bibulous, nonmembranous layers sandwich and are bonded to a semipermeable membranous layer with an adherent gelling agent to form a high-strength laminated separator. These separators find use in a variety of alkaline galvanic cells, particularly in rechargeable cells such as nickel--cadmium, nickel--zinc, silver--zinc, manganese dioxide--zinc, and similar cells. 3 figures.

3385 RESEALABLE VENT FOR PLASTIC BATTERY CASE. Sorenson, D.D.; Erickson, R.A. (to Gould Inc.). US Patent 3,980,500. 14 Sep 1976. Filed date 30 May 1975. 4p.
A resealable vent for a secondary cell has a flat plastic case including a resilient ball. The ball is seated in an apertured passage with a predetermined amount of compression and adapted to unblock an opening in the passage and vent gaseous material upon an excessive build-up of internal pressure within the cell case, for example, during recharging at an accelerated rate. 10 figures.

3386 USE OF HYDROGEN-ABSORBING ELECTRODE IN ALKALINE BATTERY. Feder, D.O.; Maurer, D.W. (to Bell Telephone Labs., Inc.). US Patent 3,980,501. 14 Sep 1976. Filed date 19 Jun 1974. 6p.
Alkaline batteries are described in which a special electrode is incorporated in the positive electrode in order to give added protection against electrochemical damage due to battery reversal. This special electrode contains a hydrogen-absorbing material which also acts as a hydrogen electrode for the conversion of hydrogen ions into elemental hydrogen. Such alkaline batteries are particularly well protected against hydrogen overpressure due to battery reversal with only a small penalty in energy density. Particularly suitable for this application is the use of a hydrogen-absorbing material with nominal formula $LnM_5$, in which Ln represents a lanthanide metal and M is either cobalt or nickel. 3 figures.

3387 ELECTRODE FOR ELECTROCHEMICAL POWER SOURCES. Sandera, J.; Calabek, M.; Cenek, M.; Kalab, R.; Koudelka, V.; Kouril, O.; Malik, J.; Vanacek, J. (to Prazska Akumulatorka). German(FRG) Patent 2,508,608/A/. 9 Sep 1976. 6p. (In German).
Available from Dt. Patentamt, Muenchen (FRG).
According to the invention, the lifetimes and shock resistance of accumulator electrodes, which are produced from a mixture of electrochemically active mass and plastic binder, are increased by coating the surface of the electrode at least partly by a porous layer of an electrically insulating material chemically resistant to the electrolyte: in particular, testile tissue; and solidly sintering the porous layer with the mixture from the electrochemically active mass and the plastic mixture.

3388 ELECTROCHEMICAL IMPREGNATION OF ELECTRODE FOR RECHARGEABLE CELL. Kroger, H.H.; Acree, S.F.; Akridge, A.P. (to General Electric Co.). US Patent 3,979,223. 7 Sep 1976. Filed date 30 Mar 1973. 6p.
An improved system for electrochemical impregnation of active material into an electrode for a galvanic cell comprises utilizing a constant potential during the impregnation as well as a screen or barrier interposed, in the bath, around the electrode while it is impregnated to mitigate the deposition of active material on the outside of the electrode surfaces. A more densely packed electrode having a higher charge rating per unit volume results. In a preferred embodiment the active material comprises a minor amount of a second ion, and the ratio of the two ions in the bath is maintained by use of a consumable electrode in the bath having the desired ratio of ions therein. 1 figure.

3389 CASTING AND PROPERTIES OF GRID ALLOYS FOR MAINTENANCE-FREE BATTERIES. Caldwell, T.W.; Sokolov, U.S.; Bocciarelli, L.M. (NL Industries, Inc., Hightstown, NJ). J. Electrochem. Soc.; 123: No. 9, 1265-1271(Sep 1976).
Microstructure, hardness, castability, and hydrogen evolution rate of cast SLI battery grids were determined for a wide range of Pb--Ca and Pb--Ca--Sn alloy compositions. Calcium oxidation rate of the molten alloys was also studied. These properties were determined as a function of alloy composition, trace element content, and casting conditions. Grids were cast on a commercial calcium--lead grid casting machine under production conditions. Grids were cast from two base leads: a low-bismuth primary lead and a refined secondary lead containing bismuth, antimony, copper, and silver. Calcium was found to affect hardness and initial aging rate, while tin influenced grain size, castability, and calcium oxidation rate. Hydrogen evolution rate was also found to be a function of alloy composition. Trace element additions influenced hardness and hydrogen evolution in Pb--Ca--Sn alloys, and calcium oxidation rate and castability in Pb--Ca alloys. Casting conditions influenced grain size and hardness at some alloy compositions. 10 figures, 3 tables.

3390 ANALYSIS OF POROUS ELECTRODES WITH SPARINGLY SOLUBLE REACTANTS. III. SHORT TIME TRANSIENTS. Gu, H. (Univ. of California, Los Angeles); Bennion, D.N.; Newman, J. J. Electrochem. Soc.; 123: No. 9, 1364-1370(Sep 1976).
A mathematical model which describes the operation of porous battery electrodes was developed. It includes short time transient behavior of electrolyte concentration, porosity, current distribution, reaction rate, and detailed solution diffusion descriptions of a sparingly soluble reactant. Calculations were made for constant current (50 and 25 mA/cm$^2$) charging and discharging of Ag/AgCl electrodes. Results of calculations indicate that the concentration of the electrolyte, KCl, inside the porous electrode plays an important role in the performance of the electrode. During charging, the electrolyte concentration falls in the depth of the electrode; the solution electrical conductivity is thereby decreased. Reaction penetration depth on charging is very shallow, less than 0.3 mm, for the current densities investigated. On discharging, the electrolyte concentration in the depth of the electrode increases. Consequently, the electrical conductivity of the solution as well as the solubility of AgCl increases. A high reaction rate in the depth of the electrode is possible even at high current discharge. Charg utilization over 90 percent is predicted if the charge is stored uniformly by employing a slow charging rate. 12 figures.

3391 ANALYSIS OF POROUS ELECTRODES WITH SPARINGLY SOLUBLE REACTANTS. IV. APPLICATION TO PARTICULATE BED ELECTRODE: AG/AGCL SYSTEM. Katan, T. (Lockheed Palo Alto Research Lab., CA); Gu, H.; Bennion, D.N. J. Electrochem. Soc.; 123: No. 9, 1370-1376(Sep 1976).
Experiments were conducted to characterize critical processes which determine performance of totally immersed, porous, secondary electrodes having sparingly soluble reactants. Particulate beds comprised of silver spheres, 37.7 +- 4.2 μm in diameter, were used as Ag/AgCl electrodes in 1N KCl. Silver chloride product distribution and facial potential as functions of time during galvanostatic charging are compared to predictions of a recently developed mathematical model. Good accord is shown over the tested time range, 1 to 19 min, and exterior current density 50 mA cm$^{-2}$. Time for onset of pore blockage with failure to accumulate charge, about 18 min, and the reaction penetration, mostly less than 0.03 cm, are predicted with reasonable accuracy. A characteristic minimum in polarization occurs during galvanostatic discharge due to reduction in pore blockage at the beginning of discharge, increase in KCl concentration in the depth of the electrode, and increase in effective matrix electronic conductivity with silver deposition. A final rise in polarization occurs when silver chloride is depleted. Theory is used to show how governing rate processes are shifted by the occurrence of blockages of the first and second kinds. 10 figures, 1 table.

3392 EFFECTS OF CHARGE RATE AND CYCLING ON THE MORPHOLOGY OF CD AND $Cd(OH)_2$ IN SINTERED PLATE ELECTRODES. Barnard, R.; Edwards, G.S.; Lee, J.A.; Tye, F.L. (Ever Ready Co., Ltd., London). J. Appl. Electrochem.; 6: No. 5, 431-444(Sep 1976).
Optical and scanning electron microscopy were used to study the growth and redistribution of Cd and $Cd(OH)_2$ in sintered-plate electrodes as a function of charge rate and cycle number. The growth of both components was found to increase with increasing cycle number and decreasing charge rate. Because the deposits, particularly after extended cycling, always contained appreciable quantities of Cd metal in both the charged and discharged state, the sizes of $Cd(OH)_2$ crystallites were

difficult to quantify. High charge and discharge rates promoted greater aggregation and redistribution of active material towards the electrode edge. This resulted in a considerable decrease in the available pore volume per unit mass of active material and in extreme cases to localized pore blockage. The trapping of Cd metal by highly crystalline, unchargeable hexagonal platelets of beta-$Cd(OH)_2$ resulted in about 50 percent of the active material's becoming obsolete after 100 cycles at high charge and discharge rates. At this stage only the finely divided Cd metal in the electrode interior continued to function. Low charge rates gave deposits of more uniform size and distribution, but these contained a high percentage of large Cd particles which discharged less efficiently than those produced at the high charge rate. 34 figures.

3393 EXPERIMENTAL OPTIMIZATION OF $LI/SOCL_2$ PRIMARY CELLS WITH RESPECT TO THE ELECTROLYTE AND THE CATHODE COMPOSITIONS. Dey, A.N. (P.R. Mallory and Co., Burlington, MA). J. Electrochem. Soc.; 123: No. 9, 1262-1264(Sep 1976).

The optimization of the $Li/SOCl_2$ C-size $sub 2$ells with respect to the parameters such as concentration of $LiAlCl_4$ source or purity of $LiAlCl_4$, and the Teflon content of the carbon cathode showed that low Teflon content, low $LiAlCl_4$ concentration, and pure $LiAlCl_4$ improve the intrinsic capacity of the cells. The optimum cell performance at moderate to high rates was obtained with 1(M) salt concentration and 10% Teflon in the cathode.

3394 METAL/AIR CELLS AND IMPROVED AIR ELECTRODES FOR USE THEREIN. Buzzelli, E.S. (to Westinghouse Electric Corp.). US Patent 3,977,901. 31 Aug 1976. Filed date 23 Oct 1974. 16p.

Air electrodes for use in electrochemical energy cells comprise a hydrophilic layer and a hydrophobic layer laminated to it. The hydrophilic layer essentially comprises a hydrophilic composite which includes an oxygen absorption/reduc ion carbon; a material selected from the group consisting of $CuWO_4$, $NiWO_4$, $CoWO_4$, and WC with 1 to 20 wt percent Co for a unifunctional electrode, or $WS_2$, WC, and WC with 1 to 20 wt percent Co for a bi-functional electrode; and a nonwetting agent containing a polytetrafluoroethylene. A metal current collector is molded into the composite to form a substantially flat hydrophilic layer. A catalyst is preferably incorporated into the composite of a bifunctional electrode to increase cycling life. The hydrophobic layer, comprising a sheet of porous fluorinated ethylene propylene, polypropylene or polytetrafluoroethylene, is laminated to the hydrophilic layer to complete the air electrodes. 11 figures.

3395 INDICATOR IN USE WITH A LEAD STORAGE BATTERY FOR INDICATING THE OVERDISCHARGE OF THE SAME AND THE LOWERED LEVEL OF THE ELECTROLYTE THEREIN. Kitai, Y. (to Shin-Kobe Electric Machinery Co., Ltd.). US Patent 3,977,908. 31 Aug 1976. Priority date 17 Oct 1972, Japan. 6p.

An indicator for use with a lead storage battery comprises a case and battery elements disposed in the case, the battery elements including electrolyte and a set of plates. The indicator is adapted to indicate the overdischarge of the storage battery and also the lowered level of the electrolyte beyond minimum allowable level. The indicator comprises a cylindrical hollow body of transparent material with the upper end of the body exposed to the top of the case and with the lower end of the body positioned substantially at the minimum allowable level of the electrolyte, the lower end of the body communicating the electrolyte within the case. A colored float is disposed within the cylindrical body for vertical movement therein. The float has a specific gravity less than that of the electrolyte when the storage battery is charged at predetermined degree and greater than that of the electrolyte when the storage battery is discharged beyond the minimum allowable degree of charge condition. Reflective means is provided in the cylindrical body at the lower end to reflect light from the upper face of the body through the thickness thereof in horizontal and vertical directions. When the storage battery is charged at more than predetermined degree, then the float is positioned in no alignment with reflective means, whereby no light passes through the float with a result that the upper face of the cylindrical body is found to shine. When the storage battery is discharged beyond the minimum allowable degree of charging condition or when it has the electrolyte level lower than the minimum allowable level, then the float is positioned adjacent to the lower end of the body in alignment with reflective means, whereby light passes through the colored float with a result that the upper face of the cylindrical body is found to provide a colored annulus. 7 figures.

3396 BATTERY RECOMBINATION REACTOR SYSTEM. Winsel, A.; Laig-Hoerstebrock, H. (to Varta Batterie Aktiengesellschaft). US Patent 3,976,510. 24 Aug 1976. Priority date 19 Nov 1973, German, Federal Republic of (F.R. Germany). 6p.

Separate cooling systems are provided for the heat of recombination and for the heat of condensation of a hydrogen recombination reactor, such as used for lead storage batteries. 6 figures.

3397 LIGHT-WEIGHT LEAD--ACID BATTERY WITH LAMINATED ELECTRODES. Cestaro, J.P.; Sokolov, U. (to NL Industries, Inc.). US Patent 3,973,991. 10 Aug 1976. Filed date 5 Mar 1975. 8p.

A light-weight lead--acid battery was prepared which contains a novel light-weight electrode assembly. The electrode assembly comprises a laminated electrode having at least three plies, the center ply being a conductive sheet and the outer two plies being sheets of a porous, compressed, and sintered homogeneous composite of synthetic fibers and lead oxide powder material.

3398 GALVANIC CELL WITH SOLID FLUORIDE ION-CONDUCTIVE ELECTROLYTE. Borger, W.; Hullmeine, U.; Voss, E. (to Varta Batterie Aktiengesellschaft). US Patent 3,973,990. 10 Aug 1976. Priority date 12 Jan 1974, German, Federal Republic of (F.R. Germany). 4p.

In a galvanic cell, there is provided a solid fluoride ion-conductive electrolyte which is a compound having the formula M/sub n/Pb/sub 1-n/F/sub 2-n/, wherein M is at least one element selected from the group consisting of potassium and rubidium, Pb is usually all lead but part of the lead may be replaced by metal more electropositive than lead, F is fluorine, and n is a positive value. 3 figures.

3399 SHEATH FOR TUBULAR STORAGE BATTERY ELECTRODES AND METHOD FOR THEIR PRODUCTION.

Sundberg, E.G.; Westberg, E. (to Aktiebolaget Tudor). US Patent 3,972,728. 3 Aug 1976. Priority date 17 Dec 1973, Sweden. 8p.

A sheath for tubular storage battery electrodes has an inner layer of an inert fibrous material and an outer layer of thermoplastic material in the form of a net, perforated foil, or the like. The two layers are mechanically joined by heating the fibrous layer to a temperature sufficient to soften the adjacent surface of the thermoplastic material and cause a portion of the fibrous layer to be embedded in the surface of the thermoplastic layer. 9 figures.

3400 METHOD OF PRODUCING ELECTRODES. Mosetti, J.; Beccu, K.D.; Jonville, P. (to Centre National d'Etudes Spatiales). US Patent 3,972,729. 3 Aug 1976. Priority date 30 Jun 1971, Switzerland. 12p.

Electrodes for primary and secondary batteries are produced by mixing a comminuted active compound with a comminuted metallic support material and then sintering the mixture under a pressure sufficient to allow the metallic particles to cohere in a temperature range of thermal stability of the active compound. The metallic support materials here specifically considered include nickel, silver, zinc, and copper. The active materials include nickel fluoride, copper fluoride, silver sulfate, and mercuric oxide in the case of positive electrodes as well as cadmium fluoride, zinc oxide, zinc sulfate, and zinc phosphate in the case of negative electrodes.

3401 PROCESS FOR MANUFACTURING A NEGATIVE ACCUMULATOR ELECTRODE FOR THE REVERSIBLE STORAGE AND RESTITUTION OF HYDROGEN. Schmitt, R. (to Battelle Memorial Institute). US Patent 3,972,726. 3 Aug 1976. Priority date 18 Oct 1973, Switzerland. 8p.

A process is described for the manufacture of negative accumulator electrodes having a current-conducting carrier skeleton and an active material for the reversible electrochemical storage and restitution of hydrogen on charging and discharging. The powder particles of the active material are at least partially enveloped and coated with a hydrogen-permeable copper layer. The copper-coated active material particles are processed by heating to sintering temperatures with simultaneous application of pressure to form a porous, mechanically-stable electrode permeated with a sintered copper carrier skeleton of sintered copper coated on the active material particles. 2 figures.

3402 OXYGEN REDUCTION ON POROUS CADMIUM ELECTRODES OF ALKALINE ACCUMULATORS. Khomskaya, E.A.; Kolosov, A.S.; Terent'ev, N.K.; Burdanova, N.F. (Saratovskij Gosudarstvennyj Univ. (USSR); Vsesoyuznyj Nauchno-Issledovatel'skij Akkumulyatornyj Inst., Leningrad (USSR)). Elektrokhimiya; 12: No. 8, 1241-1244(Aug 1976). (In Russian).

10 refs.; short communication only; for English translation see the journal Sov. Electrochem..

CADMIUM;ELECTRIC BATTERIES;ELECTRODES; ELECTROLYSIS;OXYGEN;POROSITY;CHEMICAL REACTION KINETICS;REDUCTION;HYDROXIDES;NICKEL-CADMIUM BATTERIES;SILVER-CADMIUM BATTERIES;ANODES

3403 SIMPLE BATTERY CHARGER FOR GEL CELLS DETECTS FULL CHARGE AND SWITCHES TO FLOAT. Kranz, P.; Seger, J. (Dyron Inc., Waltham, MA). Electron. Des.; 24: No. 15, 120(19 Jul 1976).

A gel-cell battery charger circuit is presented that can be built with an IC timer at a considerable parts saving over similar circuits. The circuit shown for a 6-V, 1.2-Ah cell automatically detects the full-charge state and switches to a float-charge condition--from 240 mA to 12 mA.

3404 LITHIUM ELECTRODE AND AN ELECTRICAL ENERGY STORAGE DEVICE CONTAINING THE SAME. Lai, S.C. (to Rockwell International Corp. ). US Patent 3,969,139. 13 Jul 1976. Filed date 18 Aug 1975. 12p.

An improved lithium electrode structure comprises an alloy of lithium and silicon in specified proportions and a supporting current-collecting matrix in intimate contact with the alloy. The lithium electrode of the present invention is utilized as the negative electrode in a rechargeable electrochemical cell. 3 figures.

3405 METHOD FOR PREPARING ELECTRODES FOR AN ELECTROCHEMICAL STORAGE CELL. Gadessaud, R.; Audry, C. (to Compagnie Generale d'Electricite). US Patent 3,967,976. 6 Jul 1976. Priority date 28 Mar 1974, France. 8p.

According to a first embodiment of this invention, the collector part of the electrode is formed by a full plate on which are deposited longitudinal strips of polytetrafluoroethylene before the depositing of the electrochemically active part. In a second embodiment, the collector part is formed by a grid which is coated, before the depositing of the electrochemically active part, with a zinc oxide paste and polytetrafluoroethylene. In this way, one or more spaces are provided between the collector part and the electrochemically active part, the result being that the gases given off by the reaction process may escape easily by following the space(s) and thus avoid any deformation of the electrode. 5 figures.

3406 RESIN SHEET HAVING POROUS LAYERED STRUCTURE USEFUL AS ELECTRODE SEPARATOR FOR ELECTRIC CELLS. Honda, S.; Hata, H.; Simura, Y.; Une, S. (to Sekisui Kagaku Kogyo Kabushiki Kaisha). US Patent 3,967,978. 6 Jul 1976. Priority date 30 Mar 1973, Japan. 16p.

A resin sheet having a porous layered structure useful as an electrode separator for electric cells is described. The sheet comprises an olefin resin, a finely divided inorganic substance, and at least one substance selected from the group consisting of a water-swellable thermoplastic resin, a water-insoluble or difficultly water-soluble hydrophilic nonionic surface active agent, and a water-insoluble or difficultly water-soluble hydrophilic anionic surface active agent. The sheet includes fine pores arranged throughout its cross section in a plurality of layers, at least some of them forming open cells. This sheet is prepared by a process comprising fabricating a mixture containing the above components into a sheet, and stretching the sheet in at least one direction. 2 figures.

3407 CHEMISTRY OF $TIS_3$ AND $NBSE_3$ CATHODES. Murphy, D.W.; Trumbore, F.A. (Bell Labs., Murray Hill, NJ). J. Electrochem. Soc.; 123: No. 7, 960-964(Jul 1976).

The cell discharge reactions of $NbSe_3$ and $TiS_3$ cathodes in nonaqueous lithium cells have been shown to involve three lithiums per $MX_3$. Using reaction with n-BuLi as a model for cell discharge, it is shown that cell discharge

involves topochemical reactions in which the basic structure of the $MX_3$ is maintained. Both $NbSe_3$ and $TiS_3$ are chain structures containing X-X bonds. The $(X_2)^{2-}$ groups are reducible as well as the $M^{4+}$ ion, accounting for the stoichiometry. The cell reaction is reversible for $NbSe_3$, but only partially reversible for $TiS_3$. Irreversibility in $TiS_3$ is suggested to be due to a change in coordination geometry of $Ti^{4+}$ from trigonal prismatic to octahedral. 9 figures.

3408 ANODIC BEHAVIOR OF LITHIUM IN AQUEOUS ELECTROLYTES. II. MECHANICAL PASSIVATION. Littauer, E.L.; Tsai, K.C. (Lockheed Palo Alto Research Labs., CA). J. Electrochem. Soc.; 123: No. 7, 964-969(Jul 1976).

The anodic passivation of lithium in flowing alkaline electrolytes was studied chronopotentiometrically. The experimental results reveal that the passivation follows the classical diffusion-limited process. An empirical relationship similar to the Sand equation, but including a term for the critical current, i/sub c/, is observed: (i - i/sub c/) = kt/sub p//sup $-^1/_2$/. A theoretical model of the dissolving lithium anode was formulated to explain the dependence of the time to passivation, t/sub p/, on the experimental variables. This model involves the diffusion of the soluble species through a fixed porous solid layer on the electrode surface and through the electrolyte diffusion layer. The assumption made for the initial boundary condition requires the existence at OCV of a concentration gradient within the porous oxide layer. It has led to an analytical solution which can successfully represent the i - t/sub p/ relationship for metals in highly corrosive media. 4 figures.

3409 PORE VOLUME AND DENSITY OF UNFORMED PASTES OF LEAD--ACID BATTERY PLATES. Fleischmann, C.W.; Schlotter, W.J. (Eltra Corp., Plymouth Meeting, PA). J. Electrochem. Soc.; 123: No. 7, 969-972(Jul 1976).

The specific pore volume, v, and solids' density, d, were determined for the pastes of unformed lead--acid battery plates by a simple laboratory technique. v was found to vary linearly with the apparent density of the dry paste, D, according to v = 0.356 - 0.0569D for pastes cured to develop 4PbO x $PbSO_4$ and v = 0.271 - 0.0415D for pastes otherwise cured, d was determined from the relationship $d^{-1} = D^{-1}$ - v d decreased continually with decreasing D i r all plates except those cured to develop 4PbO x $PbSO_4$. For the latter plates d went through a maximum as D decreased. This maximum is explained in terms of the differing crystalline perfections of the 4PbO x $PbSO_4$ crystals in the plates.

3410 EFFECT OF BASE LEAD COMPOSITION ON METALLURGICAL PROPERTIES OF MAINTENANCE-FREE BATTERY ALLOYS. Caldwell, T.W.; Sokolov, U.S. (NL Industries, Inc., Hightstown, NJ). J. Electrochem. Soc.; 123: No. 7, 972-977(Jul 1976).

The effects of trace element additions on the microstructure and age-hardening properties of Pb--Ca and Pb--Ca--Sn alloys for maintenance-free batteries are reported. A specific laboratory casting procedure duplicating grid solidification conditions and the solidification-cast property relationships upon which it is based are discussed. It was found that bismuth, antimony, copper, and silver in amounts typical of high bismuth primary and refined secondary base leads have little or no influence on microstructure in Pb--0.085Ca and Pb--0.085Ca--0.8Sn. The addition of trace elements increased the early hardness of Pb--0.085Ca--0.8Sn but had no effect in Pb--0.085Ca. 9 figures.

3411 ELECTROCHEMICAL PROPERTIES OF SODIUM BETA-ALUMINA IN $ZNCL_2$--NACL MELTS. Flinn, D.R.; Stern, K.H. (Naval Research Lab., Washington, DC). J. Electrochem. Soc.; 123: No. 7, 978-981(Jul 1976).

On the basis of membrane potential measurements, sodium β-alumina is shown to be almost completely selective for sodium ions in NaCl--$ZnCl_2$ melts. However, the continuous electrolysis of β-alumina in these melts decreases its conductivity. These results are interpreted in terms of the movement of mobile sodium ions becoming impeded by nearly immobile zinc ions introduced into the ceramic under the applied electric field. Beta-alumina is therefore not useful in battery applications where ions other than sodium are present. It can, however, be used in the construction of sodium ion specific membrane electrodes. 6 figures.

3412 DEPENDENCE OF THE PROPERTIES OF THE LEAD--ACID BATTERY POSITIVE PLATE PASTE ON THE PROCESSES OCCURRING DURING ITS PRODUCTION. Pavlov, D.; Papazov, G. (Bulg Acad of Sci, Sofia). J. Appl. Electrochem.; 6: No. 4, 339-345(Jul 1976).

The phase composition, microstructure, porosity, density and consistency of positive plate pastes prepared at 35 and 80$degree$C were determined as functions of the amount of H$sub 2$SO$sub 4$. It was found that the phase composition of the paste is determined by the H$sub 2$SO$sub 4$ oxidized lead powder ratio and by the temperature at which the paste is mixed. The paste density is determined by the liquid--powder ratio. The total pore volume is controlled by the paste density while the average pore radius and the consistency are determined by the phase composition. Stoichiometric calculations were made for the phase composition of the pastes. It is concluded that the paste represents a nonequilibrium system consisting of crystalline basic lead sulphates and oxides and amorphous sulphate-containing components. 10 refs.

3413 DEPENDENCE OF THE PROPERTIES OF THE LEAD-ACID BATTERY POSITIVE PLATE PASTE ON THE PROCESSES OCCURRING DURING ITS PRODUCTION. Pavlov, D.; Papazov, G. (Central Lab. for Electrochemical Power Sources, Sofia). J. Appl. Electrochem.; 6: No. 4, 339-345(Jul 1976).

The phase composition, microstructure, porosity, density, and consistency of positive plate pastes prepared at 35 and 80°C were determined as functions of the amount of $H_2SO_4$. It was found that the phase composition of the paste is determined by the $H_2SO_4$--oxidized lead powder ratio and by the temperature at which the paste is mixed. The paste density is determined by the liquid--powder ratio. The total pore volume is controlled by the paste density, while the average pore radius and the consistency are determined by the phase composition. Stoichiometric calculations were made for the phase composition of the pastes. It is concluded that the paste represents a non-equilibrium system consisting of crystalline basic lead sulfates and oxides and amorphous sulfate-containing components.

3414 MOLYBDENUM TRIOXIDE DOPED MANGANESE DIOXIDE ELECTRODE. I AND II. Valand, T.;

Gardner, C.L. (Norw Def Res Establ, Jkeller). J. Power Sources; 1: No. 1, 65-71, 73-80(Jul 1976).

A study of the chemical and electrochemical properties of manganese dioxide cathodes containing molybdenum trioxide is described. The manganese dioxide was made by the decomposition of a dissolved mixture of manganous nitrate and a small quantity of molybdenum trioxide. It was found that the chemical composition of the manganese dioxide was affected by the presence of less than 1% molybdenum trioxide. The second part deals with experimental results obtained on study with a series of molybdenum oxide doped manganese dioxides.

3415 EFFECT OF VARIOUS ACTIVE CARBON CATALYSTS ON THE BEHAVIOR OF CARBON GAS-DIFFUSION AIR ELECTRODES. I, II. Iliev, I.; Mrha, J.; Kaisheva, A.; Gamburzev, S.; Musilova, M. (Cent Lab for Electrochem Power Sources, Sofia, Bulg). J. Power Sources; 1: No. 1, 35-46, 47-56(Jul 1976).

The electrochemical behavior of carbon gas-diffusion air electrodes in alkaline solutions was investigated. Electrodes with defined structural and hydrophobic properties were chosen as a suitable system for comparing the electrochemical activity of different active carbon catalysts. The current-voltage characteristics of electrodes with 11 different active carbon catalysts were investigated when operating both with air and pure oxygen. The second part deals with the results obtained with experiments in acid solutions.

3416 INVESTIGATION ON VARIOUS CATHODIC MATERIALS IN COPPER SOLID-STATE POWER SOURCES. Lazzari, M.; Razzini, G.; Scrosati, B. (Polytech of Milan, Italy). J. Power Sources; 1: No. 1, 57-63(Jul 1976).

The electrochemical behavior, in terms of stability, polarization and cycling capability, of a series of electrode materials in a copper solid electrolyte is reported. The results indicate that, among the various materials examined, titanium disulfide and substoichiometric copper sulfide may be considered as efficient electrode materials for reversible copper solid-state cells.

3417 EFFECT OF TETRA-ALKYL AMMONIUM COMPOUNDS ON THE PERFORMANCE OF ELECTRODES OF SINTERED PLATE NICKEL-CADMIUM CELLS. Vasudeva Rao, P.V.; Vasanthi, T.; Udupa, H.V.K. (Cent Electrochem Res Inst, Karaikudi, India). J. Power Sources; 1: No. 1, 81-89(Jul 1976).

A very striking result was observed in the performance characteristics of the plates prepared with the addition of a quaternary ammonium compound to the impregnating solutions. Experimental results with different surface active agents, added to the impregnation solution, are reported.

3418 LEAD--ACID BATTERIES WITH LOW ANTIMONY ALLOYS. Berndt, D.; Nijhawan, S.C. (Varta Batterie, Kelkheim, Ger). J. Power Sources; 1: No. 1, 3-15(Jul 1976).

A report is given on lead alloys which contain between 1 and 4% antimony and which are characterized by the addition of selenium. Use of the selenium additive produces a very fine grain structure which improves castability and grid quality to a great extent.

3419 BEHAVIOR OF LEAD-BASE ELECTRODES, WITH AND WITHOUT A $PbO_2$ LAYER, IN SULFURIC ACID AS USED IN BATTERIES. Gonzalez, J.A.; Fullea, J. (Cent Nac de Invest Metal, Madrid, Spain). Rev. Metal. (Madrid); 12: No. 4, 190-196(Jul-Aug 1976). (In Spanish).

Experimental data are presented on corrosion kinetics of pure lead on Pb--Sb alloy electrodes, with or without a $PbO_2$ surface layer, in either overcharged or completely discharged electric batteries.

3420 RECHARGEABLE MERCURY ELECTRODE. Jueng, M. (to Varta Batterie Aktiengesellschaft). US Patent 3,966,493. 29 Jun 1976. Priority date 2 Apr 1969, German, Federal Republic of (F.R. Germany). 12p.

A rechargeable mercury/mercury oxide electrode is described which has a high capacity, especially for primary cells and accumulators, and which has a metal matrix with a nonpyrophoric amalgam. The electrode is capable of repeated charging and discharging cycles during which the mercury is present as mercury oxide and mercury, respectively. The electrode is capable of a flat and constant discharge curve, with an electrical current discharge approaching the theoretical capacity of the electrode. 5 figures, 4 tables.

3421 IMPREGNATION OF ELECTRODES FOR NICKEL CADMIUM BATTERIES. O'Sullivan, T.D. (to Bell Telephone Labs., Inc.). US Patent 3,966,494. 29 Jun 1976. Filed date 21 Oct 1974. 8p.

A process is described for making nickel--cadmium batteries in which the cadmium electrodes for these batteries are electrolytically impregnated under special conditions and employ a particular electrolytic solution. The electrolytic solution contains not only a soluble form of the cation of the active ingredient for the electrode and nitrate ions, but also certain other ions such as chloride, iodide, and sulfate ions, which increase the rates of impregnation and also increase the electrode loadings. In addition to obtaining more rapid and greater electrode impregnation, the present process improvements facilitate use of a continuous impregnation procedure.3 figures, 3 tables.

3422 METHOD FOR THE PRODUCTION OF LEAD STORAGE BATTERY ELECTRODES. Eriksson, T. (to Aktiebolaget Tudor). US Patent 3,966,495. 29 Jun 1976. Priority date 1 Nov 1973, Sweden. 6p.

Positive electrodes for lead storage batteries are produced by "forming" the electrodes in an alkaline electrolyte containing an anion which forms a very slightly soluble lead compound. The electrode may also be immersed, prior to forming, in pure water, an aqueous solution of sodium sulfate, and/or sodium hydroxide.

3423 X-RAY DIFFRACTION, SCANNING ELECTRON MICROSCOPY STUDY OF SEPARATOR FAILURE. Dafler, J.R.; Garwood, A.A.; Wentzel, F.W., Jr.; Campbell, B.; Chu, D.L.K. (ESB Incorporated Technnology Center, Yardley, PA). J. Electrochem. Soc.; 123: No. 6, 780-789(Jun 1976).

Resin-bonded paper separators suffer some loss of crystalline material on extended storage in battery grade $H_2SO_4$. Similar separators from cycled batteries suffer order-of-magnitude losses of crystallinity. Scanning electron microscopy found Pb salts of two kinds; those grown in regions of high and low supersaturation. The latter often obtain crystal dimensions larger than 30 μ. Comparison

with other separator materials used in Pb/acid batteries led to a model of separator failure based on mechanical abrasion, fluid motion, and crystallization in large pores. The separator matrix is weakened by brittle fracture of the fiber network, accompanied by minor hydrolytic loss of material. These lead in turn to pore enlargement that can enhance the growth of large, well-ordered crystals. A somewhat speculative mechanism for perforation failure of large-pored separators is given. 15 figures, 3 tables.

3424 SLOW POTENTIODYNAMIC STUDIES OF POROUS ALKALINE IRON ELECTRODES. Andersson, B.; Ojefors, L. (Royal Inst. of Tech., Stockholm). J. Electrochem. Soc.; 123: No. 6, 824-828(Jun 1976).

A slow potentiodynamic method where a porous iron electrode is fully discharged and charged was used to study the reactions of the alkaline iron electrode. Electrode thickness, temperature, average porosity, number of armor nets, electrolyte concentration, and carbonate contents were varied. The experiments show that high temperature, porosity, and KOH concentration increase the charge efficiency of the electrodes. High KOH concentration promotes the direct oxidation of Fe to FeOOH, and $K_2CO_3$ concentrations up to 250 g/liters do not influence the reactions of the electrode considerably. 8 figures, 1 table.

3425 MANGANESE DIOXIDE ELECTRODE. III. RELATIONSHIP BETWEEN ACTIVITIES AND STOICHIOMETRY FOR COMPOSITIONS NEAR TO $MnO_2$. Tye, F.L. (Ever Ready Co. (Holdings) Ltd., London). Electrochim. Acta; 21: No. 6, 415-420(Jun 1976).

The potential of the reaction $MnO_2 + H^+ + e \rightarrow MnOOH$ and the chemical equilibrium $MnO_2 + Mn^{2+} + 2H_2O$ reversible $2MnOOH + 2H^+$ were studied for compositions near to $MnO_2$ where the oxyhydroxide is a single homogeneous phase. An electrodeposited $\gamma$-$MnO_2$ and a Caucasian $\beta$-$MnO_2$ ore were used as starting materials, and compositions of reduced stoichiometry were reached by means of the chemical equilibrium shown above. The concentration of MnOOH is insufficient to affect significantly the chemical potential of $MnO_2$, and potential and chemical equilibrium are controlled by pH and the activity of MnOOH. The behavior observed can be quantitatively understood on the basis that, in the $\beta$-$MnO_2$, MnOOH is undissociated so that its activity is equal to its mole fraction, but that, in the $\gamma$-$MnO_2$, MnOOH is dissociated so that $Mn^{3+}$ and $OH^-$ have independent existences, and its activity is related to the product of the mole fractions of these ionic constituents. 4 figures, 1 table.

3426 EQUIPMENT FOR THE CATALYTIC RECOMBINATION OF HYDROGEN AND OXYGEN GASES PRODUCED IN ACCUMULATORS. Nann, E. (to Accumulatorenfabriken Wilhelm Hagen A.G.). German(FRG) Patent 2,455,744/A/. 26 May 1976. 17p. (In German).

3 figs..

The invention deals with closing devices (so-called catalyst stoppers) of secondary batteries which work with aqueous electrolytes. These stoppers are constructed in such a manner that they free the stoichiometric hydrogen--oxygen mixtures, occuring especially during recharging, which are recombined to steam on granular catalysts. The steam condenses on the inner wall of the stopper. The condensed water flows back into the electrolytes so that the latters' concentration remains constant. The particular characteristics of this invention are found in the optimum arrangement and construction of all components of the closing device. This guarantees a high operational safety and a practically quantitative hyrogen--oxygen recombination.

3427 CATHODE CELL CASING PORTION, A CELL CASING, AND A HERMETICALLY SEALED SODIUM--SULFUR CELL. Breiter, M.W. (to General Electric Co.). US Patent 3,959,013. 25 May 1976. Filed date 11 Jun 1975. 12p.

A cathode cell casing portion, a cell casing, and a hermetically sealed sodium--sulfur cell are disclosed. The metallic cathode cell casing portion is made of one of several specific metals with a corrosion-resistant and electronically conducting layer adhering to the inner surface of the casing. The cell casing includes the above cathode cell casing portion and an opposed anode cell casing portion joined to a ceramic ring supporting an inner casing of a solid sodium ion-conductive material. A hermetically sealed sodium--sulfur cell has the above type of casing with a sodium negative electrode in the inner casing and a positive electrode of sulfur in conductive material in the cathode casing portion surrounding the inner casing. 2 figures, 1 table.

3428 METHOD TO PRODUCE A PROTECTIVE OXIDE ON THE SURFACE OF POSITIVE NICKEL ELECTRODES FOR GALVANIC CELLS. Bauer, M.; Ewe, H.; Justi, E. (to Varta Batterie Aktiengesellschaft). US Patent 3,959,014. 25 May 1976. Priority date 14 Dec 1971, German, Federal Republic of (F.R. Germany). 4p.

The present invention relates to a method for the development of a protective oxide on the surface of porous, positive Ni-electrodes for galvanic cells with alkaline electrolyte.

3429 METHOD OF PREPARING AN ELECTRODE MATERIAL OF LITHIUM--ALUMINUM ALLOY. Settle, J.L.; Myles, K.M.; Battles, J.E. (to Energy Research and Development Administration). US Patent 3,957,532. 18 May 1976. Filed date 20 Jun 1974. 8p.

PAT-APPL-481,285.

A solid compact having a uniform alloy composition of lithium and aluminum is prepared as a negative electrode for an electrochemical cell. Lithium losses during preparation are minimized by dissolving aluminum within a lithium-rich melt at temperatures near the liquidus temperatures. The desired alloy composition is then solidified and fragmented. The fragments are homogenized to a uniform composition by annealing at a temperature near the solidus temperature. After comminuting to fine particles, the alloy material can be blended with powdered electrolyte and pressed into a solid compact having the desired electrode shape. In the preparation of some electrodes, an electrically conductive metal mesh is embedded into the compact as a current collector. 1 figure.

3430 LIGTWEIGHT NICKEL HYDROGEN CELL. Rogers, H.H. (to Sectetary of the Air Force). US Patent 3,956,015. 11 May 1976. Filed date 6 Jun 1975. 6p.

A lightweight and improved nickel--hydrogen cell composed of a plurality of parallel connected cell plates is provided by making the conductor leads from each of the plurality of plates to the electrical terminals of the cell have substantially the same electrical resistance, and contain the minimum amount of material.

3431 METAL CONTAINER FOR A GALVANIC ALKALI CELL AND METHOD FOR ITS PRODUCTION. Tsuchida, T.; Shinoda, K.; Yamamoto, K. (to Fuji Electric Co. Ltd.). German(FRG) Patent 2,317,820/C/. 6 May 1976. 5p. (In German).
1 fig. Available from Dt. Patentamt, Muenchen (FRG).
The invention deals with a metal container for a galvanic cell made of an iron base plate having a metal plating layer on its surface. Nickel or chromium have so far been used; however, pores are formed in these or they can loosen when bending the plate, resulting in the corrosion of the base plate. Plating with gold as suggested avoids these disadvantages but in extremely expensive. The object of the invention is to produce a cheap metal container for an alkali cell avoiding the named disadvantages and is achieved by making the plating layer of zinc with a chromate film by chromate treatment. The chromate film can be discolored by immersing in an alkali solution.

3432 METHOD FOR THE PRODUCTION OF GALVANIC PRIMARY ELEMENTS AND DEVICE TO CARRY OUT THE METHOD. Fraenzl, A. (to Varta Batterie A.G.). German(FRG) Patent 2,326,460/C/. 6 May 1976. 7p. (In German).
6 figs. Available from Dt. Patentamt, Muenchen (FRG).
The invention deals with a method to produce galvanic primary elements with direct insertion of the depolarization mass by means of a mouth piece into the cupular negative electrode coated with separator material. The object of the invention is to achieve a relatively narrow tolerance of weight and density in the depolarizer fabrication and to develop a process enabling a waste-free dosing of the depolarizer in the cell cup with small tolerance of weight and density inspite of the relatively inaccurate pre-dosing of the mass addition. A further aim of the invention is to design a device to carry out this method.

3433 NEW SOLID CONDUCTORS OF $NA^+$ AND $K^+$ IONS. Singer, J.; Fielder, W.L.; Kautz, H.E.; Fordyce, J.S. (Lewis Research Center, Cleveland). J. Electrochem. Soc.; 123: No. 5, 614-617(May 1976).
A search through 40 structure types for solid conductors of $Na^+$ and $K^+$ ions has produced three types capable of ion transport with conductivities in the vicinity of $10^{-5}$ $(ohm\text{-}cm)^{-1}$ at 25°C: (i) the pyrochlores $NaTaWO_6$ and $NaTa_2O_5F$; (ii) the bcc-Im3 phase of $NaSbO_3$; and (iii) the Na and K niobates near the composition $2M_2O.3Nb_2O_5$. Of these five compounds, only the K niobate (whose structure has not been elucidated) can be fully sintered without transformation. A number of phase diagrams have been developed during the course of the work. (auth)

3434 CORROSION OF LEAD ALLOYS AT HIGH ANODIC POTENTIALS. Weininger, J.L.; Siwek, E.G. (General Electric Co., Schenectady, NY). J. Electrochem. Soc.; 123: No. 5, 602-606(May 1976).
The corrosion of expanded grids of lead-antimony, lead-calcium, and lead-calcium-tin alloys maintained at constant high float charge was measured metallographically. Linear growth rates were determined for oxide growth on all three alloys. X-ray scans and maps served to locate the presence of $PbSO_4$ at the interfaces and in the bulk of the $PbO_2$ corrosion product. The results are consonant with corresponding high temperature corrosion work. This work has application to lead-acid battery design. 14 refs.

3435 PVC SEPARATORS AS ELECTRODE SPACERS IN SECONDARY BATTERIES. Kraus, H. (Hoechst, Gendorf, Ger). Plastverarbeiter; 27: No. 5, 259-264(May 1976). (In German).
The electrodes of a power cell are spaced by separators, which at the same time prevent particles of the active mass from growing from one lead plate to the other and thus the occurrence of short-circuits. The raw materials primarily used are impregnated cellulose and PVC. The latter is processed in the form of a fine powder without the usual auxiliaries such as stabilizers, lubricants, etc., using a sinter method to obtain open-pore panels. Sintering takes place without pressure but with heat, employing steel belt heating tunnels specially designed for this purpose. A special grade of suspension PVC was developed for this application, which avoids the disadvantage of a previous method by which various raw materials were blended. Technological details are given along with a sketch of sintering line for PVC powders. 15 refs.

3436 STUDY OF SOME CHARGE TRANSFER COMPLEXES AS ELECTRODES IN SOLID-STATE CELLS. Pampallona, M.; Ricci, A.; Scrosati, B.; Vincent, C.A. (Univ., Rome). J. Appl. Electrochem.; 6: No. 3, 269-274(May 1976).
The electrical and electrochemical properties of charge transfer complexes of iodine with o-tolidine, phenothiazine and N-methylphenothiazine have been investigated with a view to determining their suitability as electrodes in cells based on solid electrolytes. Discharge and polarization studies have shown that iodine electrodes based on phenothiazine and N-methylphenothiazine offer excellent prospects as practical cathodes. 12 refs.

3437 SOLID ELECTROLYTE ELEMENT. Bro, P.; Liang, C.C.; Boyle, G.H. (to Mallory (P.R.) and Co., Inc.). German(FRG) Patent 2,155,931/C/. 29 Apr 1976. 5p. (In German).
3 figs..
The invention deals with a solid electrolyte element with at least one solid electrolyte cell arranged in a hermetically closed casing where the casing has two connection contacts electrically insulated from one another, which are each electrically connected to a cell electrode.

3438 MONITOR NICAD'S WITH THIS LOW-BATTERY DETECTOR. Warner, R.T. (Wavetek, San Diego, CA). EDN Mag.; 21: No. 8, 112, 114(20 Apr 1976).
A simple, reliable, low-battery detector circuit senses the depletion level of a pack of nickel cadmium (NiCad) batteries. In the NiCad application shown, the battery floats in series with a constant-current charging circuit. A voltage regulator provides +-11 V output from a series arrangement of 24 NiCad cells whose nominal voltage is 1.25 per cell or 30 V dc total. Full charge level is nominally 32.5 V dc. The low-battery sensing circuit is referenced to a regulated -11 V supply. The circuit senses a depletion level of 24.1 V dc in this application.

3439 ENVELOPE FOR THE TUBULAR ELECTRODES OF STORAGE BATTERIES. Breidenbach, H. (to Varta Batterie Aktiengesellshaft). US Patent 3,950,186. 13 Apr 1976. Priority date 23

Jul 1973, German, Federal Republic of (F.R. Germany). 4p.

Spacers for fabric electrode tubes are made by tying off groups of warp threads of the fabric with weft threads of the same fabric. This forms ears which protrude beyond the fabric tube diameter.

3440 ELECTRIC GENERATORS PARTICULARLY DRY CELL BATTERIES. Garcin, M.M. US Patent 3,948,683. 6 Apr 1976. Priority date 20 Oct 1973, France. 8p.

A protective cap affixed to a dry cell to be removed before use includes a disc-like cap covering the exposed electrode at one end of the cell. Axial protrusions on one face of the disc extend through holes in the end face surrounding the electrode, the protrusions being deformed while in a plastic state so as to be not removable without breakage. The cap is removed by fracturing the protrusions with a rotary motion. In another embodiment a single annular flange fits in an annular groove around the electrode. Yet another embodiment includes axial and radial projections to adopt to the specific form of battery case design. A further embodiment includes a two-part cap with one part externally threaded and molded onto the electrode, and the other internally threaded and screwed onto the first. Removal is effected by tightening the second which breaks the first loose. 12 figures.

3441 STUDY OF GAS EVOLUTION IN TEFLON BONDED POROUS ELECTRODES. III. PERFORMANCE OF TEFLON BONDED PT BLACK ELECTRODES FOR $H_2$ EVOLUTION. Tseung, A.C.C.; Vassie, P.R. (City Univ., London). Electrochim. Acta; 21: No. 4, 315-318(Apr 1976).

Steady-state and potentiostatic transient $H_2$ evolution studies on Teflon-bonded Pt black, platinized Pt, and Pt foil electrodes in 5N $H_2SO_4$, 25°C showed that Teflon-bonded electrodes gave a higher performance than the other electrodes. The presence of the porous hydrophobic Teflon network ensures that not all the electrolyte will be expelled from the pores of the electrode during the gas evolution process: greater utilization of the available Pt area is thus ensured. 4 figures, 2 tables.

3442 SELF-DISCHARGE OF THE ALKALINE IRON ELECTRODE. Oejefors, L. (Royal Inst. of Tech., Stockholm). Electrochim. Acta; 21: No. 4, 263-266(Apr 1976).

The self-discharge reaction, which is a hydrogen-evolving corrosion process, where the anode reaction is identical to the first discharge step, was studied by three different methods: $H_2$ evolution, polarization curves, and potentiodynamic discharge. The influence of 28 additives at 30, 50, and 70°C on both discharge and self-discharge is shown. Most additives decrease both the self-discharge and discharge rates but the $K_2S$ and hydrazinesulfate added to the electrolyte. These two additives have a positive influence on the discharge process of the iron electrode. 3 figures, 1 table.

3443 HIGH PERFORMANCE, RECHARGEABLE SINTERED IRON ELECTRODES. I. THE EFFECT OF PREPARATIVE METHODS AND ADDITIVES ON THE STRUCTURE AND PERFORMANCE OF SINTERED IRON ELECTRODES. Vassie, P.R.; Tseung, A.C.C. (City Univ., London). Electrochim. Acta; 21: No. 4, 299-302(Apr 1976).

The effect of fabrication variables--starting material, compacting pressure, sintering temperature--on sintered iron electrodes is presented, together with an investigation of the factors governing the depth of discharge of these electrodes. Over 60 percent depth of discharge is achievable in optimized electrodes, operating at 50°C, 30 percent KOH electrolyte (containing 50 g/l of LiOH). 8 figures.

3444 ELECTROCHEMICAL FUEL CELLS. Smrcek, K. (CKD, Prague, Czech). Elektrotech. Obz.; 65: No. 4, 213-217(Apr 1976). (In Czech).

Various types of fuel cells are discussed, along with their principles of operation. The present state of universal research as well as research activities in Czechoslovakia are reported. Prospects from the viewpoint of applications are considered.

3445 CATHODE COMPOSITION FOR ELECTROCHEMICAL CELL. Steunenberg, R.K.; Martin, A.E.; Tomczuk, Z. (to Energy Research and Development Administration). US Patent 3,941,612. 2 Mar 1976. Filed date 4 Mar 1975. 10p.

PAT-APPL-555,317.

A high-temperature, secondary electrochemical cell includes a negative electrode containing an alkali metal such as lithium, an electrolyte of molten salt containing ions of that alkali metal, and a positive electrode containing a mixture of metallic sulfides. The positive electrode composition is contained within a porous structure that permits permeation of molten electrolyte and includes a mixture of about 5 percent to 30 percent by weight $Cu_2S$ in FeS. 5 tables, 4 figures.

3446 LECLANCHE ELECTROLYTE COMPOSITIONAL STUDIES FOR THIN FILM BATTERIES. Bredland, A.M.; Hull, M.N. (ESB Inc., Madison, WI). J. Electrochem. Soc.; 123: No. 3, 311-315(Mar 1976).

The effect of zinc oxide dissolution and pH rise on the crystallization behavior of a series of Leclanche electrolytes has been determined with reference to their use in thin film batteries such as the ESB-P70. An electrolyte (2725) consisting of 27% ammonium chloride and 25% zinc chloride was identified as exhibiting increased solubility of zinc oxide, increased resistance to both pH rise and harmful crystal formation when compared to the presently employed 2210 composition.

3447 STRUCTURE AND ANODIC DISCHARGE BEHAVIOR OF LITHIUM-BORON ALLOYS IN THE LICL-KCL EUTECTIC MELT. James, S.D.; DeVries, L.E. (Naval Surface Weapon Center, White Oak, MD). J. Electrochem. Soc.; 123: No. 3, 321-327(Mar 1976).

Anodic discharge curves in the LiCl--KCl eutectic melt have been obtained from two lithium--boron alloys (70 and 80 weight per cent Li) between 673° and 873° (400° and 600° and from 2 to 8 A/cm². The behavior of Li contained in wicks of porous Ni was also studied for comparison. Calculated Li contents for Li--B alloy anodes, at the main break in curvature of discharge curves, clustered closely around 0.67 mole fraction Li. The authors consider this strong evidence for the existence of a compound $Li_2B$ in this alloy system. Between 748° and 873° (475° and 600°) and up to at least 8 A/cm², there is no diffusional limitation to the anodic extraction of Li from the Li--B alloys.

3448 CORROSION IN ALKALI HYDROXIDE SOLUTIONS OF ELECTROLYTIC ZINC POWDER CONTAINING

CODEPOSITED LEAD. Moshtev, R.V.; Stoicheva, R. (Lab. of Electrochem. Power Sources, Sofia). J. Appl. Electrochem.; 6: No. 2, 163-169(Mar 1976).

The corrosion rate of electrolytic Zn sponge in alkaline solutions is controlled by codeposited Pb in concentrations from 0.2 to 0.5%. It appears that codeposited lead in this respect is as good as mercury but has the advantages of being cheaper and less toxic. The Zn sponge containing codeposited Pb offers the additional advantage of having a highly developed surface area, so that the porous electrodes pressed with such a sponge can be discharged at higher rates. The effect of KOH concentration on the corrosion rate of Zn sponge with and without Pb is explained in terms of the different mechanisms of the hydrogen evolution reaction on the Fe inclusions, on the one hand, and on pure Zn, on the other. An empirical equation for the approximate estimation of the corrosion rate of Zn sponge in 10 N KOH at 50°C as a function of Pb and Fe content in the sponge is presented. This work has application to electric batteries.

3449 CYCLIC CHARGE--DISCHARGE BEHAVIOUR OF SINTERED PLATE AND PLANAR CADMIUM ELECTRODES. Barnard, R.; Edmondson, K.; Lee, J.A.; Tye, F.L. (Ever Ready Co., Ltd., London). J. Appl. Electrochem.; 6: No. 2, 107-118(Mar 1976).

The cyclic charge--discharge behavior of sintered plate and planar cadmium electrodes was studied by using galvanostatic and potentiostatic sweep techniques. The cycling inefficiency of sintered electrodes reflected more the discharge process as shown by analytical monitoring of cadmium levels before and after charge. The effect of discharge rate on cycling efficiency was also investigated. Open-circuit recovery experiments indicated that a critical potential was reached at which passivation occurs subsequent to which a plateau region was observed for sintered electrodes. Potentiostatic sweeps on partially discharged electrodes and X-ray diffraction suggested the formation of a nickel--cadmium alloy during charge. Comparison of cyclic sweeps on sintered and planar electrodes showed the distribution effects of active material through the sinter and also the improved charge acceptance of sintered electrodes. Cyclic sweeps on planar electrodes indicated the involvement of forms of cadmium of different activity, whilst cathodic sweeps after prolonged retention at potentials anodic to passivation indicated a more complex reduction route. 11 figures.

3450 IMPROVEMENT TO AUTOMATIC NICD BATTERY CHARGER. Roll, I.; Shenton, M.; Lucas, D. (Thorn Autom, Rugeley, Staffs, Engl). Electron. Eng.; 48: No. 577, 17(Mar 1976).

A recent paper in this magazine [v 47 n 574 Dec 1975 p 19 by G. Bottomley titled "Automatic Charger for Nickel-Cadmium Batteries"] introduced the possibility of using a 555 timer as a level-sensitive flip-flop in an automatic charger for nickel-cadmium cells. While the basic idea of charging the cells for a period and then testing them to check the voltage was very good, it is shown in this paper how the circuit could be improved by inserting a simple constant current generator to replace a given resistor. The final circuit has three advantages: the correct charging current will be delivered into any load voltage up to about 14 V; charging is at constant current, the correct way to charge a NiCd cell; by the addition of a range switch, a selection of cells may be charged with the same unit.

3451 HALOGEN HYDRATES. Symons, P.C. (to Energy Development Associates). US Patent 3,940,283. 24 Feb 1976. Filed date 7 Feb 1975. 18p.

A process for useful storage of electrical energy employing halogen hydrates is described. The halogen hydrate can be generated during the charging of a secondary battery or may be chemically generated and placed in a primary battery. 10 figures, 4 tables

3452 COMPARTMENTED ELECTRODE STRUCTURE. Vissers, D.R.; Shimotake, H.; Gay, E.C.; Martino, F.J. (to Energy Research and Development Administration). US Patent Application 657,525. 12 Feb 1976. 13p.

Electrodes for secondary electrochemical cells are provided with compartments for containing particles of the electrode reactant. The compartments are defined by partitions that are generally impenetrable to the particles of reactant and, in some instances, to the liquid electrolyte used in the cell. During cycling of the cell, reactant material initially loaded into a particular compartment is prevented from migrating and concentrating within the lower portion of the electrode or those portions of the electrode that exhibit reduced electrical resistance. 3 figures, 1 table.

3453 ELECTROPHORETIC MOBILITIES OF CADMIUM HYDROXIDE, NICKEL HYDROXIDE, AND SILVER OXIDE IN NI--CD AND AG--ZN BATTERY ELECTROLYTES. Mayer, S.W. (Aerospace Corp., El Segundo, CA). J. Electrochem. Soc.; 123: No. 2, 159-162(Feb 1976).

Since cadmium migration damage of separators is a major cause of Ni--Cd battery failures or performance degradation, a series of electrophoretic mobility measurements was made for cadmium hydroxide suspensions in concentrated KOH battery electrolyte at several concentrations of $K_2CO_3$ to investigate whether electrophoresis of cadmium hydroxide could be the mechanism for migration to separators. It was found that the mobility of the cadmium hydroxide suspension in an applied electrical field is adequate to account for the observed migration of cadmium hydroxide to separators. The view that high carbonate concentrations in Ni--Cd battery electrolyte may increase cadmium migration damage of separators is consistent with these electrophoretic measurements since it was demonstrated that increasing $K_2CO_3$ concentration from 0.8 to 6.2 percent increased cadmium hydroxide migration by a factor of 3. Zeta potentials were calculated from the data. Similar measurements have been made for nickel hydroxide suspensions in Ni--Cd battery electrolyte at several $K_2CO_3$ concentrations. The results are consistent with ion probe analyses for nickel in nylon separators exhibiting considerable cadmium migration. Silver oxide mobility reached a maximum at 5.1 percent $K_2CO_3$ and declined at 15.8 percent $K_2CO_3$. 3 tables. (auth)

3454 LITHIUM--ALUMINUM ELECTRODE. James, S.D. (Naval Surface Weapons Center, Silver Spring, MD). Electrochim. Acta; 21: No. 2, 157-158(Feb 1976).

The Li--Al solid alloy has been used as the negative electrode in experimental molten salt secondary batteries. Its rest potential has been studied as a function of composition and temperature. This work describes voltage--time curves for Al wires electrolytically charged with Li and discharged in the LiCl--KCl

eutectic melt at 703°K (430°C). These preliminary data show the charging process to be much less polarized than the discharge, which seems to be diffusion limited. 2 figures. (RWR)

3455 METHOD OF PREPARING POROUS, ACTIVE MATERIAL FOR USE IN ELECTRODES OF SECONDARY ELECTROCHEMICAL CELLS. Vissers, D.R.; Nelson, P.A.; Kaun, T.D.; Tomczuk, Z. (to Energy Research and Development Administration). US Patent Application 652,696. 27 Jan 1976. 21p.

Particles of carbonaceous matrices containing embedded electrode active material are prepared for vibratory loading within a porous electrically conductive substrate. In preparing the particles, active materials such as metal chalcogenides, solid alloys of alkali or alkaline earth metals along with other metals and their oxides in powdered or particulate form are blended with a thermosetting resin and particles of a volatile to form a paste mixture. The paste is heated to a temperature at which the volatile transforms into vapor to impart porosity at about the same time as the resin begins to cure into a rigid, solid structure. The solid structure is then comminuted into porous, carbonaceous particles with the embedded active material. 1 figure, 4 tables.

3456 ANODE FOR A SECONDARY, HIGH-TEMPERATURE ELECTROCHEMICAL CELL. Vissers, D.R.; Tani, B.S. (to Energy Research and Development Administration). US Patent 3,933,521. 20 Jan 1976. Filed date 13 Feb 1975. 10p.

PAT-APPL-549,635.

A high-temperature, secondary electrochemical cell includes an anode containing lithium, an electrolyte containing lithium ions, and a cathode containing a chalcogen material such as sulfur or a metallic sulfide. The anode includes a porous substrate formed of, for instance, a compacted mass of entangled metallic fibers providing interstitial crevices for receiving molten lithium metal. The surfaces of the interstitial crevices are provided with a coating of cobalt metal to enhance the retention of the molten lithium metal within the substrate. 2 tables, 3 figures.

3457 METHOD OF PREPARING ELECTRODES WITH POROUS CURRENT COLLECTOR STRUCTURES AND SOLID REACTANTS FOR SECONDARY ELECTROCHEMICAL CELLS. Gay, E.C.; Martino, F.J. (to Energy Research and Development Administration). US Patent 3,933,520. 20 Jan 1976. Filed date 3 Apr 1975. 12p.

PAT-APPL-565,021.

Particulate electrode reactants, for instance transition metal sulfides for the positive electrodes and lithium alloys for the negative electrodes, are vibratorily compacted into porous, electrically conductive structures. Structures of high porosity support sufficient reactant material to provide high cell capacity per unit weight while serving as an electrical current collector to improve the utilization of reactant materials. Pore sizes of the structure and particle sizes of the reactant material are selected to permit uniform vibratory loading of the substrate without settling of the reactant material during cycling. 1 table, 7 figures.

3458 NEW TYPE OF LECLANCHE BATTERY. II. STUDY OF AN INTERMITTENT REGIME. Dalard, F.; Le Gorrec, B.; Machat, J.Y.; Guitton, J. (Domaine Univ., St. Martin d'Heres, France). J. Appl. Electrochem.; 6: No. 1, 45-49(Jan 1976). (In French).

The improvements contributed by the electrolyte $Mg(ClO_4)_2[Mg(OH)_2$ to the preservation and to the efficiency of the couple $Zn--MnO_2$ during continuous discharge are counter-balanced by bad performances for heavy intermittent discharges. It is shown here that neither $MnO_2$ nor the internal resistance of the battery were responsible, but that the depassivation of the zinc is insufficient with the $ClO_4^-$ 70 ion alone. The presence of $Cl^-$ ion sensibly improves the depassivation. A mixture of $ClO_4^-$ and $Cl^-$ ought to give a good compromise between preservation and performance during heavy intermittent discharges.

3459 MECHANICAL AND CORROSION PROPERTIES OF LOW ANTIMONY LEAD ALLOYS. Rogatchev, T.; Ruevski, St.; Pavlov, D. (Cent. Lab. of Electrochem. Power Sources, Bulg. Acad. of Sci., Sofia). J. Appl. Electrochem.; 6: No. 1, 33-36(Jan 1976).

The mechanical properties (tensile strength, hardness, and relative elongation) of lead alloys containing 2 to 3% Sb, 0.1 to 0.5% Sn, and 0.1 to 0.5%As in the as-cast state and after annealing and quenching were determined. It is established that quenching significantly improves the mechanical properties of the alloys. By variation of the tin content and the thermal treatment conditions it is possible to obtain within certain limits the desired mechanical properties. The anodic dissolution c.d. of lead, and lead alloys containing 2.2% Sb, 0.11% As, and 0.25% Sn, was determined as a function of the potential. It is found that this alloy has a higher rate of anodic dissolution and lower oxygen overvoltage than those of pure lead. These alloys are used in electric batteries.

3460 MECHANICAL AND CORROSION PROPERTIES OF LOW ANTIMONY LEAD ALLOYS. Rogatchev, T.; Ruevski, S.; Pavlov, D. (Central Lab. of Electrochemical Power Source, Sofia). J. Appl. Electrochem.; 6: No. 1, 33-36(Jan 1976).

The mechanical properties (tensile strength, hardness, and relative elongation) of lead alloys containing 2 to 3% Sb, 0.1 to 0.5% Sn, and 0.1 to 0.5% As in the as-cast state and after annealing and quenching were determined. It is established that quenching significantly improves the mechanical properties of the alloys. By variation of the tin content and the thermal treatment conditions it is possible to obtain, within certain limits, the desired mechanical properties. The anodic dissolution c.d. of lead, and lead alloys containing 2.2% Sb, 0.11% As, and 0.25% Sn, was determined as a function of the potential. It is found that this alloy has a higher rate of anodic dissolution and lower oxygen overvoltage than those of pure lead.

3461 PROPERTIES OF SOME MIXED ORGANIC ELECTROLYTE SOLUTIONS AND THEIR EFFECTS ON THE ANODIC PERFORMANCES OF MG ELECTRODES. Saito, T.; Ikeda, H.; Matsuda, Y.; Tamura, H. (Osaka Univ., Suita, Japan). J. Appl. Electrochem.; 6: No. 1, 85-88(Jan 1976).

The properties of electrolyte solutions composed of mixed organic solvents with perchlorates and the polarization characteristics of Mg anodes in these solutions were investigated. Formamide, acetonitrile, propylene carbonate, tetrahydrofurane, and 1,2-dimethoxyethane were employed, along with sodium and lithium perchlorate. The electrical conductivity of the electrolyte was measured

with an impedance bridge using 1 kHz AC. The test electrode was a Mg plate. 4 figures, 4 tables. (RWR)

3462 HEAT TRANSFER ANALYSIS OF METAL HYDRIDES IN METAL--HYDROGEN SECONDARY BATTERIES. Onischak, M. (Energy Research Corp., Danbury, CT); Dharia, D.; Gidaspow, D. pp 7B.37-7B.50 of Hydrogen energy. Vol. II. Veziroglu, T.N. (ed.). Coral Gables, FL; Univ. of Miami (1976).

From 1. world hydrogen energy conference; Miami Beach, Florida, USA (1 Mar 1976).

See CONF-760304--P2.

The heat transfer between a metal--hydrogen secondary battery and a hydrogen-storing metal hydride was studied. Temperature profiles of the endothermic metal hydrides and the metal--hydrogen battery were obtained during discharging of the batteries by assuming an adiabatic system. Two hydride materials were considered in two physical arrangements within the battery system. In one case the hydride is positioned in a thin annular region about the battery stack; in the other the hydride is held in a tube down the center of the stack. The results show that for a typical 20 ampere-hour battery system with lanthanum pentanickel hydride as the hydrogen reservoir the system could perform successfully. (auth)

3463 DEVELOPMENT OF A COMPACT, HIGH-CAPACITY $FeS_2$ ELECTRODE. Shimotake, H.; Walsh, W.J. (Argonne National Lab., IL). Am. Chem. Soc., Div. Fuel Chem., Prepr.; 19: No. 5, 59-66(1976).

From 168. national meeting of American Chemical Society; Atlantic City, New Jersey, USA (8 Sep 1974).

See CONF-740955--P2.

The development of compact, high-capacity $FeS_2$ electrodes which have been used as components of rechargeable engineering cells is described. These cells, which involve molten lithium negative electrodes and LiCl--KCl eutectic electrolyte at 430°C, have achieved specific energies greater than 150 Wh/kg. A series of experiments with 7.5-cm-dia Li--Al/$FeS_2$ cells was conducted to test various electrode configurations. It was found that a configuration consisting of a porous bed of $FeS_2$ particles with molybdenum current collectors provided a highly efficient electrode structure. A thin ceramic cloth was used to retain particulates within the electrode, and electrode expansion was minimized by using a strong exterior support structure. Stable capacities of 0.8 to 1.0 Ah/$cm^3$ of electrode volume were achieved. Coulombic efficiencies of approximately 100 percent and energy efficiencies exceeding 80 percent were attained. Conversions of $FeS_2$ (to $Li_2S$ and Fe) of 70 and 95 percent were attained upon discharge at the 4- and 10-h rates, respectively. Average cell voltages of 1.50 V were achieved with lifetimes exceeding 1000 h. 4 figures

3464 ADVANCES IN COMPONENT TECHNOLOGY FOR NICKEL--ZINC CELLS. Charkey, A. (Energy Research Corp., Danbury, CT). pp 452-456 of Eleventh intersociety energy conversion engineering conference. Vol. I. New York; American Institute of Chemical Engineers (1976).

From 11. intersociety energy conversion engineering conference; State Line, Nevada, USA (12 Sep 1976).

See CONF-760906--P1.

This paper reviews the progress made at ERC by delineating the work accomplished thus far in improvements in electrode structure, separator system cell construction, and cycle life, and indicates problem areas which still remain. Nickel electrodes were developed and tested which are capable of over 800 deep discharge cycles; zinc electrodes, which are capable of over 500 deep discharge cycles; separators, which are immune to oxidative attack; and 300-Ah cells, which can be produced with the above improvements at projected costs approaching $50/kWh. Failure mechanisms include loss of nickel electrode capacity by zinc oxide poisoning and graphite oxidation and loss of capacity by drying out of the zinc electrode. Progress is being made in both areas, and it is possible to project cycle life capability for nickel--zinc cells exceeding 1000 deep cycles. 10 figures, 2 tables. (RWR)

3465 ENGINEERING EVALUATION OF SOLID TRANSITION-METAL SULFIDE ELECTRODES FOR USE IN HIGH ENERGY-DENSITY BATTERIES. Marmaduke, B.A.; Donaghey, L.F. (Univ. of California, Berkeley). pp 467-470 of Eleventh intersociety energy conversion engineering conference. Vol. I. New York; American Institute of Chemical Engineers (1976).

From 11. intersociety energy conversion engineering conference; State Line, Nevada, USA (12 Sep 1976).

See CONF-760906--P1.

Solid electrode materials exhibiting anomalously high alkali ion diffusivities through layered structures were studied for application in high-energy-density, fast-discharge-rate batteries. The maximum storage capacity and maximum discharge rates were studied theoretically for a spectrum of transition metal sulfides which crystallize in the $CdI_2$ and $MoS_2$ structures. Simple criteria were established for screening potentially important solid electrode materials for battery applications. 1 figure, 4 tables.

3466 REVIEW OF ELECTRODE DESIGNS AND FABRICATION TECHNIQUES FOR LITHIUM--ALUMINIUM/IRON SULFIDE CELLS. Gay, E.C.; Kaun, T.D.; Martino, F.J. (Argonne National Lab., IL). pp 477-484 of Eleventh intersociety energy conversion engineering conference. Vol. I. New York; American Institute of Chemical Engineers (1976).

From 11. intersociety energy conversion engineering conference; State Line, Nevada, USA (12 Sep 1976).

See CONF-760906--P1.

A number of electrode designs and fabrication techniques were evaluated in order to identify the most suitable electrodes to meet the Li--Al/iron sulfide battery performance goals for off-peak energy storage in utility networks and for electric-vehicle propulsion. This paper describes several positive and negative electrode designs and fabrication procedures that have been sufficiently successful to warrant further development. A major effort is being directed to the development of pressed and carbon-bonded iron sulfide electrodes. The carbon-bonded electrode was formed from a three-component paste of active material, volatile substance, and carbon cement. After heating and driving off the volatile, a structure is formed in which the active material is held in a porous carbon lattice. Pressed electrodes were formed by hot or cold pressing mixtures of active material and electrolyte on a metal current collector. Investigations of charged and uncharged Li--Al/iron sulfide cells indicate that the perfomance goals can be met with several electrode designs. The final choice of electrodes is based on the ease of manufacture

and component costs. 3 figures, 5 tables.

3467 $^{7}$LI SELF DIFFUSION IN LIAL: AN NMR STUDY. Willhite, J.R.; Karnezos, N.; Cristea, P.; Brittain, J.O. (Northwestern Univ., Evanston, IL). J. Phys. Chem. Solids; 37: No. 12, 1073-1076(1976).

The self diffusion of $^{7}$Li in near stoichiometric LiAl has been investigated by observing the $^{7}$Li and $^{27}$Al NMR relaxation rates. The diffusivity for a $^{7}$Li atom is determined to be $D = 9 \times 10^{-6} \exp(-0.12\ eV/kT)$ $cm^2/s$. Both the $^{7}$Li and $^{27}$Al rates show the effects of quadrupole relaxation. The electric field gradients from the moving defects in LiAl are a factor of 37 +- 5 stronger at the Al nuclei, suggesting covalent character to the bonding.

3468 TRANSPORT PROCESSES IN ZINC--SILVER OXIDE BATTERY SEPARATORS. de Pinho, M.N.N.C. Gainesville, FL; Univ. of Florida (1976). 142p. University Microfilms Order No. 77-8213.

Thesis (Ph. D.).

Diffusion, electrolytic conduction, and convection are known to occur in solution. The mechanisms of the first two processes through porous media were investigated. The separator was modelled as a continuous fictitious medium described by global properties--effective diffusivity and electrolytic conductivity. Diffusion rates were measured by use of an electrochemical technique; the electrical currents generated were diffusion controlled. The separator was assumed isotropic. The current--time dependence yielded two asymptotic solutions: in the short-time solution, the current decreases monotonically with the square root of time; the magnitude of the currents is dependent on the concentration of the electroactive species and the electrode area and is independent of the separator thickness; in the steady-state solution, the currents vary linearly with concentration of the electroactive species, electrode area and reciprocal of separator thickness. Diffusion rates were correlated with measurable geometrical parameters of the porous matrix (thickness and cross-sectional area), electrolyte (concentration of electroactive species), and the effective diffusion coefficient of the separator. Experimental data are in reasonably good agreement with the predicted asymptotic behavior. Different types of separators were characterized by an effectiveness factor. Electrolytic conduction was related not only to the geometrical parameters of the porous matrix and the electrolyte concentration, but also to parameters characterizing the solid-electrolyte interface. In the measurements of electrolytic conductance through porous media, other transport processes than electromigration take place. For asbestos separators, surface conductances at different electrolyte concentrations were calculated.

3469 FORMATION OF BATTERY PLATES. Burkett, W.B.; Orsino, J.A. (to McCulloch Corp.). US Patent 3,929,505. 30 Dec 1975. Filed date 27 Jun 1973. 18p.

Plates for batteries are formed by applying formation current and intermittently depolarizing the plates and electrolyte at either preselected intervals or in response to one or more monitored characteristics of the plates and electrolyte. Plates for lead-acid batteries are formed while immersed in either a dilute solution of sulfuric acid or the solution to be used as the electrolyte in the battery. The formation current for plates for lead--acid batteries is in excess of 20 times the usual formation current, and may be more than 100 times the usual formation current. 5 figures (auth)

3470 ELECTRODE ASSEMBLY FOR BIPOLAR BATTERY. Fritts, D.H. (to Dept. of the Air Force). US Patent Application 642,524. 19 Dec 1975. 10p.

A bipolar electrode having, between active materials, a heat sink fabricated from a porous electrical and heat conductive material, such as sintered silver, is described. The porous material is impregnated with a phase-change heat-absorbent material having a high heat of fusion, such as beeswax. The electrode has a very large thermal capacity for a high-discharge-current-density battery.

3471 THERMAL BATTERY. Bush, D.M.; Nissen, D.A. (to Energy Research and Development Administration). German(FRG) Patent 2,523,248/A/. 18 Dec 1975. 13p. (In German).

3 figs..

To avoid failure of thermal batteries containing calcium anodes which could be caused by short circuit of the conducting electrodes, the calcium anode is provided with a coating of $Ca(OH)_2$ of between 0.01 to 0.1 mm thick, which is produced by an oxidizing atmosphere saturated with steam on the surface of the calcium anode.

3472 IMPROVED THERMAL BATTERY. Bush, D.M. (to Energy Research and Development Administration, Washington, D.C. (USA)). German(FRG) Patent 2,524,037/A/. 18 Dec 1975. 11p. (In German).

The patent specification claims the chemical composition of fusible solid electrolyte plates of thermal batteries which contain calcium anodes and heat generating plates. The homogeneous mixture of the electrolyte plates consists of calcium chromate depolarizer, a silicon diode binder and a mixture of calcium chloride, lithium chloride and calcium hydroxide.

3473 METHOD OF MANUFACTURING POSITIVE NICKEL HYDROXIDE ELECTRODES. Gutjahr, M.A.; Schmid, R.; Beccu, K.D. (to Battelle Memorial Inst.). US Patent 3,926,671. 16 Dec 1975. Priority date 7 Jun 1973, Switzerland. 8p.

A method of manufacturing a positive nickel hydroxide electrode is discussed. A highly porous core structure of organic material having a fibrous or reticular texture is uniformly coated with nickel powder and then subjected to a thermal treatment which provides sintering of the powder coating and removal of the organic core material. A consolidated, porous nickel support structure is thus produced which has substantially the same texture and porosity as the initial core structure. To provide the positive electrode including the active mass, nickel hydroxide is deposited in the pores of the nickel support structure.

3474 PHENOLIC RESIN AND BATTERY SEPARATOR IMPREGNATED THEREWITH. Jones, R.T. (to Monsanto Co.). US Patent 3,926,679. 16 Dec 1975. Filed date 9 Jan 1974. 8p.

Battery separators comprising a cellulose substrate thoroughly impregnated with an admixture of resole resin and a polyol antimigratory agent are described. The resole resin is a one-stage resin with a formaldehyde

to phenol mol ratio between 1.6:1 and 2.8:1 and a molecular weight in the range of 130 to 300. After the cellulose substrate is impregnated with the admixture, it is heated to advance the resole to the infusible state. The substrate exhibits improved oxidation resistance in an acidic oxidation environment. 2 tables.

3475 METHOD OF MANUFACTURING FUEL CELL ELECTRODES. Tsuchida, T.; Shinoda, K.; Yamamoto, K.; Murata, T.; Maeda, Y. (to Fuji Electrochemical Co., Ltd.). US Patent 3,926,678. 16 Dec 1975. Priority date 31 Aug 1972, Japan. 4p.

There is provided a method of manufacturing an electrode for a fuel cell which comprises kneading a mixture of silver oxide powder and active carbon powder with a water-repellent binder, molding the kneaded mixture to a thin catalyst layer, heating it under pressure to effect drying and activation of the catalyst simultaneously, and integrating the resulting thin catalyst layer with a metallic collector net and a gas-permeable film by application of heat pressure.

3476 LEAD--ACID STORAGE BATTERY PASTE. Taylor, D.F.; Siwek, E.G. (to General Electric Co.). US Patent 3,926,670. 16 Dec 1975. Filed date 23 Oct 1973. 6p.

A lead--acid battery paste is described which consists of at least one battery lead oxide, lithium sulfate, and water. 1 table.

3477 METAL/AIR CELLS AND AIR CATHODES FOR USE THEREIN. Buzzelli, E.S. (to Westinghouse Electric Corp.). US Patent 3,925,100. 9 Dec 1975. Filed date 26 Feb 1974. 6p.

An air cathode for use in metal/air cells is described comprising a hydrophobic layer laminated to a hydrophilic layer wherein the hydrophilic layer comprises a metal current collector integrally molded into a composition comprising: (i) an oxygen absorption/reduction carbon, (ii) 50 to 70 percent by weight manganese dioxide, (iii) at least one of polytetrafluoroethylene and fluorinated ethylene propylene, and (iv) Ag-Hg catalyst. The hydrophobic layer preferably comprises a sheet of porous, unsintered, completely fibrillated polytetrafluoroethylene which is laminated to the hydrophilic layer. A metal/air cell is provided which includes said air cathode together with a spaced apart anode selected from iron, zinc, cadmium, or like metal, in an alkali hydroxide electrolyte.

3478 METHOD OF PREPARING A NEGATIVE ELECTRODE INCLUDING LITHIUM ALLOY FOR USE WITHIN A SECONDARY ELECTROCHEMICAL CELL. Tomczuk, Z.; Olszanski, W.; Battles, J.E. (to Energy Research and Development Administration). US Patent Application 639,133. 9 Dec 1975. 11p.

A negative electrode that includes a lithium alloy as active material is prepared by briefly submerging a porous, electrically conductive substrate within a melt of the alloy. Prior to solidification, excess melt can be removed by vibrating or otherwise manipulating the filled substrate to expose interstitial surfaces. Electrodes of such a solid lithium--aluminum filled within a substrate of metal foam are provided. 1 figure, 1 table.

3479 WATER-FREE ELECTROCHEMICAL CELL. Blomgren, G.E.; Kronenberg, M.L. (to Union Carbide Corp.). German(FRG) Patent 2,521,216/A/. 4 Dec 1975. 23p. (In German).

1 fig.; 1 tab..

The invention deals with a water-free electrochemical cell with an anode, or cathodic current collector, and a cathodic electrolyte. In particular, it applies to primary and secondary non-aqueous electrochemical cells containing certain inorganic, liquid halogens which are simultaneously the active cathodic depolarizer and the solvent for the dissolved salts contained in the electrolyte.

3480 ZINC ELECTRODE FOR AN ELECTROCHEMICAL POWER SOURCE. Sandera, J.; Calabek, M.; Kouril, O.; Cenek, M.; Vanacek, J.; Malik, J.; Koudelka, V. (to Prazska Akumulatorka). German(FRG) Patent 2,519,704/A/. 4 Dec 1975. 5p. (In German).

The invention deals with a zinc electrode for an electrochemical power source with a shunt and an electrode mass of a mixture of zinc powder or of powdery zinc compounds with a medium to increase the porosity and with a binder. The electrode is especially designed for accumulator of the nickel--zinc, silver--zinc and zinc--oxygen (air) systems.

3481 GRID STRUCTURE FOR HIGH RATE LEAD/ACID BATTERY. Margulies, R.S.; Biddick, R.E. (to Environmental Protection Agency). US Patent 3,923,545. 2 Dec 1975. Filed date 30 Mar 1973. 4p.

An improved electrode grid structure is formed wherein at least two equispaced current-carrying separators are tapered in width and intersect at the widest portion perpendicular to a tapered side element having a current collecting tab. In addition, the number of current-carrying separators parallel to the tapered current-carrying separators is greater than the number of current-carrying separators perpendicular to the tapered current-carrying separators. The purpose of the structure is to maximize mechanical support while minimizing the resistive paths in regions of highest current density. 1 figure.

3482 SULFUR--SULFIDE ELECTRODE IN MOLTEN SALTS. I. CHRONOPOTENTIOMETRIC BEHAVIOR IN LITHIUM CHLORIDE--POTASSIUM CHLORIDE EUTECTIC. Weaver, M.J.; Inman, D. (Imperial Coll. of Science and Tech., London). Electrochim. Acta; 20: No. 12, 929-936(Dec 1975).

By means of cathodic chronopotentiometric and potentiometric studies of (nominally) polysulfide solutions in LiCl--KCl eutectic at temperatures between 400 and 440°C, the predominant solute species present at concentrations around $10^{-2}$ M was shown to be polysulfide $S^{2-}$/sub x/. This conclusion is in harmony with earlier spectral and electrochemical studies in LiCl--KCl eutectic. The chronopotentiometric oxidation of sulfide ion $S^{2-}$ in the same melt is rather complex, but it appears to be controlled by the extensive formation of a polymeric sulfur film, although a mixture of various soluble polysulfides is ultimately formed. Various detailed mechanisms that can account for the observed behavior are discussed. 5 figures, 1 table.

3483 AUTOMATIC CHARGER FOR NICKEL--CADMIUM BATTERIES. Bottomley, G. Electron. Eng.; 47: No. 574, 19(Dec 1975).

The 555 timer IC can be used as a precise level-sensitive flip-flop. With its high current capability, it can form the basis of a simple charger for nickel--cadmium batteries. A more sophisticated circuit is also described. It can be made using two 555 IC's. This circuit tests the battery on load, as some

manufacturers recommend. The battery is alternately charged for 30 seconds and tested for 100 ms until it is fully charged.

3484 ALKALINE BATTERY SEAL AND PROTECTIVE COATING COMPRISING A FATTY ACIDAMIDE. Winger, J. (to Union Carbide Corp.). US Patent 3,922,178. 25 Nov 1975. Filed date 28 Aug 1973. 6p.

A fatty polyamide is employed as a seal or a protective coating in order to prevent alkaline electrolyte from wetting a surface in an alkaline galvanic cell. 4 figures. (auth)

3485 CHARGING CIRCUIT FOR BATTERY-OPERATED DEVICES POWERED BY SOLAR CELLS. Mellors, G.W.; Powers, R.A.; Sheffield, G.W. (to Union Carbide Corp.). US Patent 3,921,049. 18 Nov 1975. Filed date 25 Sep 1973. 6p.

A charging circuit for battery-operated devices is powered by photovoltaic cells comprising a first diode means connected in parallel to a series-connected resistor and at least one photovoltaic cell, and in parallel to a series-connected second diode means and at least one secondary battery. The terminals of the components of the circuit are connected such that the current from the photovoltaic cells is limited by the first diode means so as to prevent overcharge of the secondary battery while the second diode means is connected as to prevent reverse current through the photovoltaic cells when the voltage of the secondary battery is higher than that of said photovoltaic cells. (Official Gazette)

3486 ELECTRODES FOR STORAGE BATTERIES. Westberg, E.; Andersson, J.; Sundberg, E. (to Aktiebolaget Tudor). US Patent 3,920,479. 18 Nov 1975. Priority date 4 Dec 1972, Sweden. 4p.

A method of fabricating and a sheath for the active material-surrounded conductive rods of a lead--acid storage battery of the liquid electrolyte type is described in which a tubular sheath composed of fibers has short lengths of the end portions mechanically bonded by application of a thermoplastic material in a molten liquid form. 5 figures. (auth)

3487 ALKALINE STORAGE BATTERY AND ZINC NEGATIVE ELECTRODE THEREFOR. Enters, R.F. (to McGraw-Edison Co.). US Patent 3,918,990. 11 Nov 1975. Filed date 25 Oct 1974. 4p.

An alkaline-electrolyte storage battery having nickel and zinc active materials for the positive and negative electrodes is characterized by the use of perforated metal strip pockets for the negative electrodes containing a powdered zinc active material under pressure to hold the active material in situ and in close electrical contact with the metal strip. By preventing loss of active zinc material during cycling, a greatly extended cycle life is obtained at nearly the initial electrical capacity of the battery. (auth)

3488 BATTERY SEPARATOR. Palmer, N.I.; Sugarman, N.; Grammer, D.O. (to W. R. Grace and Co.). US Patent 3,918,995. 11 Nov 1975. Filed date 12 Dec 1972. 11p.

Lead--acid battery separators can be made from nonwoven mats of treated polypropylene resin which contain an internal surfactant which is soluble in the molten polymer but not in the cooled polymer. Heating and compression are used to increase the effectiveness of the above surfactant in conjunction with another one coated on the surface. (RWR)

3489 BATTERY SEPARATOR SHEET. Hollenbeck, B. (to W. R. Grace and Co.). US Patent 3,917,772. 4 Nov 1975. Filed date 10 Feb 1972. 6p.

A plastic material, preferably oil filled, is pressed between rollers to produce projections on the surface. Secondary molding may follow immediately. (RWR)

3490 ION EXCHANGE MEMBRANES IN ELECTROCHEMICAL CELLS. Richter, G. (Siemens, Erlangen, Ger.). Chem.-Ing.-Tech.; 47: No. 22, 909-913(Nov 1975). (In German).

New developments of ion exchange membranes displaying high chemical and mechanical stability permit effective separation of the cathode and anode spaces in electrochemical cells. Increasing use has been made of ion exchange membranes in industrial plant during the past few years. Large scale production of common salt from seawater in Japan utilizes electrodialysis. Adaptation of alkali chloride electrolysis to membrane cells is expected to take place in the next few years. Interesting applications of ion exchange membranes are found in electrochemical cells for electrolysis of water and in fuel cells. In biomedical technology they open up new pathways in the development of sensors and current sources for implantation. 23 refs.

3491 PROBLEM ON THE MECHANISM OF CALCIUM POISONOUS ACTION ON POWDER CADMIUM ELECTRODE. Rozovskii, V.M.; Solov'eva, N.A.; Samoilova, G.V. Zh. Fiz. Khim.; 49: No. 11, 2892-2895(Nov 1975). (In Russian).

For English translation see the journal Russ. J. Phys. Chem..

The causes of calcium poisoning of Cd electrodes in alkali solution were investigated. The electrodes were made of CdO to which Cd was added, and KOH solutions served as the electrolyte. The technological capacity of Cd electrodes dropped in the presence even of small amounts of Ca. It was shown that Ca inhibits cathodic reduction of CdO. On the basis of galvanostatic, potentiostatic and temperature-kinetic studies it was shown that the poisoning of powdered Cd electrode is due to changes in the ionic conductivity of CdO and an increase in the activation energy for the cathodicreduction of CdO. The effective energy of activation for CdO with a calcium admixture is approximately twice greater in comparison with pure cadmium oxide.

3492 EFFECT OF LEAD STRUCTURE OF THE POSITIVE ELECTRODE OF SECONDARY ELECTRIC BATTERIES ON ITS ELECTRIC EFFICIENCY. Skoluda, E.; Dzczesniak, B.; Tabat, S. (Centralne Lab. Akumulatorow i Ogniw, Poznan, Poland). Przem. Chem.; 54: No. 11, 648-650(Nov 1975). (In Polish).

The structures of standard positive mass as well as that of synthetic $4PbO.PbSO_4$ were examined by means of x-ray diffraction and electron microscope. The transformation of $4PbO.PbSO_4$ into a tetragonal variety $\beta PbO_2$ usually occurs in the metasomatic way. The positive mass of synthetic $4PbO.PbSO_4$ is characterized by its electric capacitances being by 40--50% larger than that of standard mass.

3493 ALKALINE BATTERY. Morioka, Y.; Dejima, S. (to Sanyo Electric Co., Ltd.). German(FRG) Patent 2,516,530. 30 Oct 1975. Priority date 15 Apr 1974, Japan. 15p.

Alkaline batteries can be improved by welding thin conducting plates to the electrodes by use of small, protruding, convex elevations of plates. Nickel--cadmium, nickel--zinc, and silver--zinc batteries are among the ones which can be thus improved. (RWR)

3494 INTERELECTRODE SEPARATOR FOR ELECTROCHEMICAL CELL. Battles, J.E.; Mrazek, F.C. (to U.S. Energy Research and Development Administration). US Patent 3,915,742. 28 Oct 1975. Filed date 7 May 1974. 6p.
PAT-APPL-467,683.
A high-temperature electrochemical cell includes an anode containing an alkali metal, a cathode containing a chalcogen, and an electrically insulative separator wetted with electrolyte between the electrodes. The separator is a porous layer of boron nitride processed to be substantially free of $B_2O_3$. This purification prevents the formation of an electrically conductive layer resulting from reactions involving boron oxide. 2 figures. (auth)

3495 CONTINUOUS PRODUCTION OF COVERS FOR TUBULAR BATTERY ELECTRODES. Sundberg, E.G.; Andersson, J. (to Aktiebolag Tudor). German(FRG) Patent 2,515,554. 23 Oct 1975. Priority date 9 Apr 1974, Sweden. 6p. (In Swedish).
A process for continuous production of covers for tubular battery electrodes is described. Both pretreatment and the main treatment are performed on a mandrel to obtain the proper cross section. (RWR)

3496 NEGATIVE ELECTRODE FOR SOLID ELECTROLYTE CELLS. Galli, R.; Olivani, F. (to Montecatini Edison SpA). US Patent 3,912,536. 14 Oct 1975. Priority date 27 Mar 1971, Italy. 6p.
An alkali metal negative electrode is disclosed for solid electrolyte electrochemical devices, consisting essentially of a solution of an alkali metal in one or more aprotic organic solvents. Complexing agents for the alkali metal may be present in the solution. The alkali metal solution may be saturated with respect to the alkali metal, which may be present as solid phase. The aprotic organic solvents may be selected from the class consisting of ethers, polyethers, N-hexalkylphosphotriamides and tertiary amines. 1 figure, 2 tables (auth)

3497 DOUBLE WALLED TUBES FOR POSITIVE PLATES OF LEAD CELLS. Serengay, M.; Lanari, G. British Patent 1,409,501. 8 Oct 1975. Filed date 20 Jun 1972. 4p.
Patent; fabrication method. CATHODES;TUBES; PLATES;LEAD-ACID BATTERIES;FABRICATION;FIBERS; DIELECTRIC MATERIALS

3498 ELECTRICAL BATTERY. Groby, C.; Crafoord, C.G.; Grieves, J. (to Aktiebolaget Tudor). US Patent 3,910,800. 7 Oct 1975. Filed date 4 Jun 1974. 4p.
An electric storage battery having a handle formed as a sub-assembly to allow one or two persons to carry the battery is described. The sub-assembly includes an intermediate member that has a surface which is secured along the mid-section of the battery cover and one or more upwardly extending arms which carry hinges to which the handles are attached. The handles are shaped to cover the terminal posts. The filler caps are attached to bars which are also mounted to the ends of the intermediate member by means of hinges. 7 figures (auth)

3499 STABLE NICKEL OXYHYDROXIDE (NIOOH). Megahed, E.; Spellman, P.J.; Tennare, L. (to ESB Inc.). US Patent 3,911,094. 7 Oct 1975. Filed date 28 Jan 1974. 7p.
NiOOH is material useful for battery cathodes (for Ni/Fe, Ni/Cd, and Ni/Zn batteries, for example). It can be prepared by dry ozonation of a powdered mixture of $Ni(OH)_2$ and alkali metal hydroxide at approx 15°. The product does not evolve oxygen when placed in contact with alkaline solutions. (RWR)

3500 MEASURING ACID DENSITY IN STORAGE BATTERIES. Reissland, M.U.; Schweizer, W. (to VDO Adolf Schindling AG). German(FRG) Patent 2,462,039. 2 Oct 1975. Filed date 22 Mar 1974. 9p.
The device described is a sensor in the shape of a battery stopper, which is dipped into the battery acid. The acid density is determined by measuring the capacity of the unit, consisting of two concentric acid-resistant plastic carriers which are coated with an electrically conducting layer and an acid-resistant layer. Poly(methylmethacrylate) can be used as the acid-resistant plastic. (RWR)

3501 STUDY OF GAS EVOLUTION IN TEFLON BONDED POROUS ELECTRODES. II. FACTORS AFFECTING THE MECHANICAL STRENGTH. Vassie, P.R.; Tseung, A.C.C. (City Univ., London). Electrochim. Acta; 20: No. 10, 763-765(Oct 1975).
Electrocatalysts are normally fine powders aggregated together. For electrocatalysts, such as graphite prepared by mechanical grinding, the particles are held together by capillary forces, and these are very much weaker than the chemical bonds which link the particles of electrocatalysts prepared by chemical methods, e.g. platinum black. Teflon-bonded platinum black electrodes can withstand long periods of gas evolution at c.d. of up to 1 A $cm^{-2}$ without physical deterioration, while Teflon-bonded graphite electrodes prepared in the same way break up at less than 30 mA $cm^{-2}$. In addition, it was shown that by increasing the volume percentage of Teflon from 5 to 16 percent the strength could be significantly improved. These electrodes gave a higher performance for gas evolution reactions, but suffered a loss in gas dissolution performance. 7 figures, 1 table.

3502 STUDY OF GAS EVOLUTION IN TEFLON BONDED POROUS ELECTRODES. I. THE MECHANICAL AND CHEMICAL STABILITY OF TEFLON BONDED GRAPHITE ELECTRODES. Vassie, P.R.; Tseung, A.C.C. (City Univ., London). Electrochim. Acta; 20: No. 10, 759-761(Oct 1975).
The mechanical and chemical stability of Teflon-bonded graphite electrodes operating in the oxygen evolution mode in 5N KOH was studied as a function of c.d. and time. The electrode starts to break up at 13 mA $cm^{-2}$ and, on subsequent cathodic oxygen reduction, performance is greatly reduced. Moreover, significant decrease in cathodic performance also occurs when the electrode has been operated at anodic currents of only 1 mA $cm^{-2}$. It is concluded that the deterioration is not due to oxidation of graphite to $CO_2$ or CO, but to the mechanical disintegration of the electrocatalyst structure, as well as the formation of solid graphite oxides. 5 figures.

3503 POSITIVE SEAL FOR BATTERIES EMPLOYING PLASTIC CASINGS. Schenk, R.L. Jr. (to Gould

Inc.). US Patent 3,909,300. 30 Sep 1975. Filed date 21 Jan 1974. 22p.

Methods and apparatus for positive displacement bonding and, more particularly, for automatically forming, on a continuous, reproducible basis, fusion bonds devoid of structural, electrical, and cosmetic defects between two or more workpieces are described. By moving a heated electrode into the area to be bonded so as to heat and melt uniformly the portions of the workpieces to be bonded while, at the same time, displacing substantially all of the molten material from the area to be bonded into a storage area or reservoir surrounding the heated electrode where such molten material is maintained in its uniformly heated molten state, and then retracting the electrode so as to permit the molten material to return to the cavity formed by the electrode in the workpieces where such molten material is allowed to cool and solidify, a flawless bond between the workpieces is formed. Improved sealing means are also used. Thermal or fusion bonds are made in accordance with the methods of the invention and with the apparatus of the invention by a combination of elevated temperature levels sufficient to melt the material to be bonded and displacement of the molten material, as contrasted with more conventional techniques and/or apparatus, which combine elevated temperature levels and pressure. 17 figures (auth)

3504 METHOD OF MANUFACTURING BATTERY PLATE GRIDS. Hammond, J.E.; Williams, A. (to Joseph Lucas (Industries) Ltd.). US Patent 3,909,293. 30 Sep 1975. Priority date 29 Apr 1971, United Kingdom of Great Britain and Northern Ireland (UK). 4p.

A battery plate grid includes an open, rectangular conductive framework, a conductive battery plate lug integral with the framework, a plurality of parallel ribs extending between a pair of opposite frame members of the grid, and a plurality of strands arranged to define a lattice structure bounded by the framework, the interstices of the lattice structure being arranged to receive the active material of the battery plate. To manufacture the grid, a strip of grid material is blanked to produce a preform grid having the same weight as the finished grid and having a rectangular framework of substantially the same dimensions as that of the finished grid. The preformed grid also includes a lattice structure defined by a plurality of strands and arranged so that the dimensions of the lattice structure in a direction perpendicular to the plane of the preformed grid are less than the corresponding dimensions of the lattice structure of the finished grid. After blanking, the strands of the preformed grid are displaced in such a manner as to increase the dimension of the lattice structure in a direction perpendicular to the plane of the grid to the value required in the finished grid. 5 figures (auth)

3505 LEAD STORAGE BATTERY. Sekido, S.; Fukuda, S. (to Matsushita Electric Industrial Co., Ltd.). US Patent 3,909,292. 30 Sep 1975. Priority date 27 Oct 1971, Japan. 12p.

A lead storage battery with electrodes made of non-woven fabric of lead fibers is described. The electrodes are porous and have a large specific surface area. This structure results in a higher utilization rate of lead and higher energy density. 21 figures, 2 tables (auth)

3506 BATTERIES COMPRISING VENTED ELECTRODES AND METHOD OF USING SAME. Carr, P. (to Energy Development Associates). US Patent 3,909,298. 30 Sep 1975. Filed date 16 Jul 1973. 10p.

An electrode for use in an electrical energy storage device is described which comprises a first side and a second side, thereby forming a channel for flow of an electrolyte with gas dissolved therein, whereby the first side has holes for venting of undissolved gas. 4 figures (auth)

3507 COMMUTATOR BAR-FREE CADMIUM ELECTRODE FOR AN ALKALINE BATTERY. Levina, V.I.; Leperson, Yu.A.; Nikol'skii, V.A.; Pashanina, N.E. USSR Patent 486,405. 30 Sep 1975. Filed date 24 Dec 1973. vp.

A method for preparing this type of electrode is described. A support is impregnated in a basic Cd solution, formed, and dried. The electrode thus prepared is then impregnated in a solution of a manganese salt. Impregnation in a $MnSo_4$ solution improves the electrical properties of the electrode. (RWR)

3508 COMMUTATOR BAR-FREE NICKEL OXIDE ELECTRODE FOR AN ALKALINE NICKEL--ZINC BATTERY. Bachaev, A.A.; Mikhalenko, M.G.; Flerov, V.N. (to Polytechnic Inst.). USSR Patent 486,404. 30 Sep 1975. Filed date 18 Dec 1973. vp.

A method for preparing this type of electrode is described. A support is impregnated in solutions of nickel salts and a base containing a manganese compound, and then forming. Electrical properties can be improved by impregnation in an alkaline solution of $KMnO_4$. (RWR)

3509 HYDROPHILIC ELECTRODE AND ITS FABRICATION. Baker, B.S.; Klein, M.G. (to Energy Research Corp.). German(FRG) Patent 2,511,557/A/. 25 Sep 1975. 14p. (In German).

1 tab..

The invention deals with hydrophilic electrodes or electrode structures to be used with galvanic elements or batteries and a method for their fabrication. The present invention makes electrodes or electrode structures for batteries using polytetrafluoroethylene as binder for the active electrode material and, furthermore, designs a method to fabricate such electrodes or electrode structures for battery purposes.

3510 PROCEDURE FOR FABRICATING ELECTRODES FOR GALVANIC ELEMENTS AND ACCUMULATORS USING POROUS FRAMEWORKS WHICH ARE MADE SURFACE CONDUCTIVE OR DESIGNED WITH CONDUCTING INSERTS. Kandler, L.; Roemer, D. (to Rheinisch-Westfaelisches Elektrizitaetswerk A.G.). German(FRG) Patent 1,421,560/C/. 25 Sep 1975. 2p. (In German).

The invention deals with a method to fabricate electrodes for galvanic elements and accumulators using porous frameworks of plastic, glass fiber, etc., which are made surface conductive or are designed with conducting inserts where the pores of the framework are filled with active mass by electrolysis.

3511 ELECTROLYTE FOR HIGH-TEMPERATURE SODIUM SOURCE OF ELECTRIC ENERGY. Demidov, A.I.; Morachevskii, A.G. (to Polytechnical Inst., Leningrad). USSR Patent 485,515. 25 Sep 1975. Filed date 2 Nov 1973. vp. (In Russian).

The electrolyte consists of various proportions of NaOH with NaI and/or NaBr. One

of the components is added as a solid to the melt of the remaining components at the battery working temperature. (RWR)

3512 BATTERY GRID PLATE. Dalibard, G. (to Compagnie Europeenne d'Accumulateurs). German(FRG) Patent 2,512,049. 25 Sep 1975. Priority date 21 Mar 1974, France. 6p.

Lead alloys which can replace the somewhat unsatisfactory high-antimony alloys used for lead--acid battery plates were studied. These new alloys contain no more than 3.5 percent Sb, with small amounts (less than 0.3 percent) of Te, As, Sn, and in some cases Ag. (RWR)

3513 HALOGEN HYDRATES. Symons, P.C. (to Energy Development Associates, Madison Heights, MI). US Patent 3,907,592. 23 Sep 1975. Filed date 11 Jan 1974. 14p.

Patent; halogen storage by means of hydrates. HALOGEN COMPOUNDS;HYDRATES;CHEMICAL PREPARATION;AQUEOUS SOLUTIONS;ELECTRIC BATTERIES;ZINC-CHLORINE BATTERIES;LITHIUM-CHLORINE BATTERIES;PHASE DIAGRAMS;ZINC CHLORIDES;CHLORINE;WATER;BROMIDES;CHLORIDES; ELECTRODES;STORAGE

3514 CATHODE FOR A SECONDARY ELECTROCHEMICAL CELL. Gay, E.C.; Martino, F.J. (to U.S. Energy Research and Development Administration). US Patent 3,907,589. 23 Sep 1975. Filed date 18 Jan 1974. 10p. PAT-APPL-434,459.

An electrochemical cell which comprises an alkali metal anode, a molten salt eutectic including that alkali metal in ionic form, and an improved cathode is described. The cathode composition comprises a transition metal sulfide such as $FeS_2$, a particulate current collector, e.g., carbon black, electrolyte and a sulfide product, e.g., $Li_2S$, of the cell reaction in excess of that produced by electrochemical reaction of the transition metal sulfide with the alkali metal in the discharge of the cell. Operation of the cell is performed by first electrocharging the cathode in series with the anode to convert the sulfide reaction product into a usable cathode reactant submerged in molten electrolyte. 5 figures. (auth)

3515 METHOD OF MANUFACTURING LEAD ELECTRODES FOR STORAGE CELLS. Jonville, P.; Stoehr, H.; Beccu, K.D. (to Battelle Memorial Inst.). US Patent 3,907,594. 23 Sep 1975. Priority date 12 Feb 1973, Switzerland. 8p.

A method of manufacturing electrodes for lead storage batteries is described. Molten lead or lead alloy is deposited on a felt of glass fibers by spraying in a molten state to fill the space between the fibers of the felt to form an electrically conductive zone defining electrode contacts. A mass of powdered lead-based material is introduced into the felt by filtration for subsequently producing an active electrode mass by at least one electrochemical transformation. The felt is then cut into individual electrodes. (auth)

3516 ELECTROCHEMICAL CELL AND SAFETY RESISTOR THEREFOR. Bergum, B.C. (to ESB Inc.). US Patent 3,907,588. 23 Sep 1975. Filed date 21 Jan 1970. 8p.

An electrochemical cell is disclosed having a resistive element interposed between a cell electrode and its corresponding terminal. The resistive element acts as a safety resistor, and is a high resistivity material which has a high temperature coefficient of resistance. The element significantly lessens the high flash amperage current which is characteristic of some electrochemical cells, such as nickel--cadmium cells. The resistance of the element preferably has a value as determined in accordance with the equation R/sub a/ = E/1/sub p/ - E/1/sub i/, where R/sub a/ is the ohmic value of the element, E is the open circuit voltage of the cell, I/sub i/ is the initial flash current of the cell in the absence of the element, and I/sub p/ is the flash current of the cell with element present in the cell. 2 figures, 1 table (auth)

3517 NONWOVEN MAT BATTERY SEPARATORS. Prentice, J.S. (to Exxon Research and Engineering Co.). US Patent 3,907,604. 23 Sep 1975. Filed date 9 Oct 1969. 6p.

Separators of polyropylene with fibers 1 to 10 μm if diameter were studied. It was found that the strip tensile strength of nonwoven mat separators could be increased by fuse bonding fibers at approx 300°F while the mat was subjected to pressure great enough to prevent shrinking. (RWR)

3518 ALUMINUM ELECTRODE. Saunders, R.C. (to Rockwell International). US Patent 3,907,590. 23 Sep 1975. Filed date 5 Jul 1974. 6p.

An improved anode for a rechargeable battery is described. It has several electrical conductors for support and electrical continuity. At least one of these is attached to the battery case in such a way as to allow anode movement during operation and charging. It is designed for use in a battery with an aluminum or Al--Li alloy anode, a molten salt electrolyte, and a sulfur-containing cathode. (RWR)

3519 DIFFUSION ELECTRODE. Yee, Wung Dai; Deibert, M.C. (to Monsanto Co.). German(FRG) Patent 1,671,453/C/. 18 Sep 1975. 7p. (In German).

3 figs..

The invention applies to the production of a membrane-shaped diffusion electrode which is produced by mixing an electron material in powder form with a polymer binder and a liquid dispersant and heating the mixture up to a temperature near the fusing temperature but below the melting point of the binder.

3520 IRON ELECTRODES. Patton, J.T.; Langer, A. (to Westinghouse Electric Corp.). German(FRG) Patent 2,510,707. 18 Sep 1975. Priority date 14 Mar 1974, United States of America (USA). 7p.

A method for preparing anodes for Edison cells is described. Powdered iron or iron oxides are mixed with carbon black and an organic resin, cast, and heated to approximately 950° to carbonize the resin. Activation is by immersion in saturated aqueous $H_2S$. (RWR)

3521 ACID DISPENSERS FOR DRY CHARGED BATTERIES. Sabatino, A. (to Gould, Inc.). Canadian Patent 974,583. 16 Sep 1975. Filed date 24 Nov 1969. 10p.

LEAD-ACID BATTERIES;ELECTROLYTES;CONTAINERS; SULFURIC ACID;DESIGN

3522 LEAD--ACID PLATE WITH LOW DUSTING CHARACTERISTICS. Weissman, E.Y.; Mahato, B.K. (to Globe-Union Inc.). US Patent 3,905,829. 16 Sep 1975. Filed date 26 Jan 1973. 5p.

A type of lead--acid battery plate which produces less lead dust during handling than presently made ones can be produced by coating the surface of the pasted plate with a water-soluble polymeric compound. The compound should be one which does not interfere with the electrical properties of the plate. Suitable compounds include PVA, polyethylene glycol, alkylcellulose, acrylic resins, and starches. They may be applied in powder form or in aqueous solution. (RWR)

3523 METAL PERMANGANATE AND METAL PERIODATE ORGANIC ELECTROLYTE CELLS. Dey, A.N.; Holmes, R.W. (to P. R. Mallory and Co., Inc.). US Patent 3,904,432. 9 Sep 1975. Filed date 19 Apr 1972. 6p.

A cathodic active material is described which utilizes the permanganates and periodates of heavy metals and preferably of silver. These materials are particularly suitable for use as positive electrodes in nonaqueous electrolyte cells, and such electrodes and the cells are described. A method for fabrication of the active material into cathodes is included. 7 figs, 1 table. (auth)

3524 LEAD--ACID BATTERIES: USE OF CARBON FIBER--LEAD WIRE GRIDS AT THE POSITIVE ELECTRODE. Weininger, J.L.; Morelock, C.R. (General Electric Co., Schenectady, NY). J. Electrochem. Soc.; 122: No. 9, 1161-1167(Sep 1975).

LEAD-ACID BATTERIES;GRIDS;CARBON;FIBERS; WIRES;PERFORMANCE;GLASS;LEAD;LEAD BASE ALLOYS; TIN ALLOYS;CALCIUM ADDITIONS

3525 ANODIC BEHAVIOR OF SILVER IN ALKALINE SOLUTIONS. Gibbs, D.B.; Rao, B.; Griffin, R.A.; Dignam, M.J. (Univ. of Toronto). J. Electrochem. Soc.; 122: No. 9, 1167-1174(Sep 1975).

Interest in the anodic behavior of silver in alkaline solutions has been stimulated in recent years by the widening use of silver/silver oxide electrodes in storage batteries. The anodic behavior of silver was investigated under controlled diffusion conditions in alkaline solutions. Experiments were carried out under linear flow control and also by using a rotating disk electrode. The electrical and optical properties of the silver oxide films were measured. On the basis of these results, difficulties involved with surface roughness in interpreting diffusion layer kinetics are pointed out. Finally, a mechanism is suggested for $Ag_2O$ film formation under stirred conditions, involving dissolution of silver followed by precipitation, the rate-controlling step for which is nucleation of steps on the oxide surface.

3526 LEAD--ACID BATTERIES: USE OF CARBON FIBER--LEAD WIRE GRIDS AT THE POSITIVE ELECTRODE. Weiniger, J.L.; Morelock, C.R. (General Electric Research and Development Center, Schenectady, NY). J. Electrochem. Soc.; 122: No. 9, 1161-1167(Sep 1975).

Conducting carbon fibers were introduced into the positive grid of the lead--acid battery in a structure which resembled a grid of pipecleaners. The carbon fibers are compatible with the environment of the positive electrode of the cell. In conjunction with Pb--Ca--Sn alloy wires or pure lead wires, the fibers prolong the cycle life of the battery, increase the high-discharge-rate capability, and can decrease the weight of the battery. Scanning electron microscopy showed the function of the carbon fibers to be an extension of the lead wire grid, thereby participating in the solution-precipitation mechanism of the electrode reaction. For comparison, a grid with glass fibers was also studied.

3527 BATTERY ELECTRODE MADE OF A NUMBER OF INDIVIDUAL SMALL TUBES BOUND IN SERIES. Sundberg, E.G. (to Aktiebolag Tudor). German(FRG) Patent 2,507,584. 28 Aug 1975. Filed date 22 Feb 1974. 16p.

ELECTRIC BATTERIES;ELECTRODES;TUBES;DESIGN

3528 MULTICOMPONENT CATHODES FOR A CELL WITH MOLTEN LITHIUM CHLORIDE--POTASSIUM CHLORIDE ELECTROLYTES. Buzzelli, E.S. (to Westinghouse Electric Corp.). German(FRG) Patent 2,507,519. 28 Aug 1975. Filed date 26 Feb 1974. 10p.

Patent; C + $Sb_2S_3$, $WS_2$, or $MoS_2$, >210 Wh/lb at 450°. CATHODES;LITHIUM CHLORIDES;POTASSIUM CHLORIDES;MOLTEN SALTS;CARBON;ANTIMONY SULFIDES; TUNGSTEN SULFIDES;MOLYBDENUM SULFIDES;RESINS; LITHIUM ALLOYS;ALUMINIUM ALLOYS;LITHIUM-SULFUR BATTERIES

3529 SEALING PLUG WITH BUILT-IN RECOMBINATION CATALYST FOR SECONDARY BATTERIES. Reber, H. (to Bosch, Robert, GmbH). German(FRG) Patent 2,408,556. 28 Aug 1975. Filed date 22 Feb 1974. 10p.

CLOSURES;SEALS;CATALYSTS;RECOMBINATION; OXYGEN;HYDROGEN;GASES;DESIGN;WATER;ELECTROLYTES; ELECTRIC BATTERIES

3530 LEAD/LEAD CHLORIDE ELECTRODE. Coleman, J.R. (to Canada, Minister of National Defence). Canadian Patent 973,607. 26 Aug 1975. Filed date 6 Dec 1971. 19p.

Patent; preparation. ELECTRODES;LEAD;LEAD CHLORIDES;CARBON;WATER;DRYING;COMPRESSION;HIGH PRESSURE;GRAPHITE;FABRICATION;CATHODES;ELECTRIC BATTERIES

3531 APPARATUS AND METHOD FOR TERMINATING THE CHARGE OF STORAGE BATTERIES. Duddy, J.C. US Patent 3,901,729. 26 Aug 1975. Filed date 28 Sep 1971. 8p.

When the fully charged battery is subjected to further charging, gas bubbles are evolved from cathode and anode plate groups. A gas-reacting electrode, arranged so that the evolving gas bubbles strike it, produces an output current corresponding to the rate of bubble evolution. The change in this output can be used to terminate the charging process. (RWR)

3532 RECHARGEABLE ZINC ELECTRODES. Schneider, C. (to Deutsche Automobilgesellschaft mbH). German(FRG) Patent 2,407,444. 21 Aug 1975. Filed date 16 Feb 1974. 13p.

Patent; fabrication. ZINC;ELECTRODES; HYDROXIDES;ZINC COMPOUNDS;LAYERS;POLYMERS; COPPER;GRIDS;SUPPORTS;FABRICATION;ELECTRIC BATTERIES;SILVER-ZINC BATTERIES;NICKEL-ZINC BATTERIES;ZINC-MANGANESE BATTERIES;ZINC-AIR BATTERIES;ZINC-CHLORINE BATTERIES;ANODES

3533 IMPROVEMENTS TO MULTICELLED ELECTRIC BATTERIES. Morton, H. (to Oldham International Ltd.). German(FRG) Patent 2,504,065. 21 Aug 1975. Filed date 14 Feb 1974. 10p.

Patent; automatic electrolyte level control. ELECTRIC BATTERIES;ELECTROLYTES;LEVELS;CONTROL;

EQUIPMENT;CONTROL SYSTEMS

3534 NEGATIVE COBALT ELECTRODES. Saridakis, N. (to Volkswagenwerk AG). German(FRG) Patent 2,405,820. 21 Aug 1975. Filed date 7 Feb 1974. 7p.
Patent; fabrication by pressing and sintering. ELECTRIC BATTERIES;HYDROXIDES;COBALT; ANODES;PRESSING;SINTERING;VERY HIGH TEMPERATURE

3535 STORAGE BATTERY. Shoichiro, I., Ohya, T.; Nagai, S. (to Yuasa Battery Co., Ltd.). US Patent 3,900,341. 19 Aug 1975. Filed date 12 Jul 1973. 6p.
Mass production of lead--acid batteries includes housing battery plates with envelope-type separators. The separator is prepared by depositing a solution of synthetic resin, solvent, and nonsolvent on a base, drying it, folding the separator around the plate, and heat sealing it. The solution can be made of PVC, tetrahydrofuran, and ethanol, this being placed on a base of polyester or polypropylene nonwoven fabric. (RWR)

3536 NEGATIVE ELECTRODE GRID. Steig, H. (to Accumulatorenfabriken Wilhelm Hagen AG Soest-Kassel-Berlin). German(FRG) Patent 2,404,642. 14 Aug 1975. Filed date 31 Jan 1974. 23p.
ANODES;GRIDS;FABRICATION;ELECTRIC BATTERIES

3537 ANODE FOR LEAD BATTERIES. (to Accumulatorenfabriken Wilhelm Hagen AG Soest-Kassel-Berlin). German(FRG) Patent 2,404,650. 14 Aug 1975. Filed date 31 Jan 1974. 10p.
Patent; Sn coating for Cu grid to prevent undesirable electrochemical reactions. LEAD-ACID BATTERIES;ANODES;IMPURITIES;COPPER; ELECTROCHEMISTRY;CHEMICAL REACTIONS;GRIDS; COATINGS;TIN;FABRICATION

3538 FILTER CAP FOR STORAGE BATTERIES. Sundberg, E.G. (to Aktiebolaget Tudor). US Patent 3,899,358. 12 Aug 1975. Filed date 12 Apr 1973. 4p.
A filter cap for a storage battery of the type which gives off gases during its work cycle is described. The filter cap separates droplets of liquid from the gases and allows the droplets to return to the battery. The filter section comprises substantially vertical walls of microporous material that are separated to provide passageways for the released gases. (auth)

3539 ELECTRODES INCLUDING MIXED TRANSITION METAL OXIDES. Rinaldi, R.V.; Wynn, J.E. (to Secretary of the Army). US Patent 3,899,357. 12 Aug 1975. Filed date 16 Jul 1973. 4p.
Mixed transition metal oxides are made by a partial reduction of stoichiometric mixtures of the required salts based on the proportion of the metal ion in the oxide being prepared and a firing of the partially reduced mixtures at 800°C in a carbon monoxide-rich atmosphere. The mixed transition metal oxides are used as catalysts in air oxygen cathode structures in practical battery applications. This invention relates to mixed transition metal oxides, to their method of manufacture, and to the use of the oxides as catalysts in air oxygen cathode structures in practical battery applications. 1 table (auth)

3540 NONACID BATTERY PASTE. O'Connor, M.J. (to Hercules Inc.). Canadian Patent 972,804. 12 Aug 1975. Filed date 11 Dec 1970. 11p.
FABRICATION;LEAD OXIDES;SLURRIES;WATER; POLYMERS;CELLULOSE ESTERS;LEAD COMPOUNDS; ELECTRODES;ELECTRIC BATTERIES;LEAD-ACID BATTERIES

3541 BATTERY PASTE AND BATTERY PLATE STRUCTURE. Batdorf, J.B.; O'Connor, M.J. (to Hercules Inc.). Canadian Patent 972,802. 12 Aug 1975. Filed date 11 Dec 1970. 16p.
SLURRIES;WATER;LEAD OXIDES;CELLULOSE ESTERS; POLYMERS;NITRIC ACID;SULFURIC ACID;SULFUR DIOXIDE;SULFUR TRIOXIDE;NITROGEN OXIDES; ELECTRODES;ELECTRIC BATTERIES;LEAD-ACID BATTERIES

3542 FORMATION OF ELECTRODES FOR ALKALINE BATTERIES. Maurer, D.W.; Schull, L.L. (to Bell Telephone Labs., Inc.). US Patent 3,899,351. 12 Aug 1975. Filed date 12 Jun 1974. 6p.
A process for forming battery electrodes made of such materials as nickel, cadmium, zinc, silver, and mercury is discussed. Plates are charged and discharged at high rates at 50° to 60° in concentrated KOH or NaOH. Currents of 4 to 10 times the ampere-hour capacity of the battery can be used, and thus the procedure takes less than 30 minutes. (RWR)

3543 SEMICONDUCTOR ELECTRODE DEPOLARIZER. Charkey, A.; Kober, F.P. (to Electrochem, Inc.). US Patent 3,898,103. 5 Aug 1975. Filed date 13 May 1971. 4p.
Patent; Ag--CuO electrode. ZINC-AIR BATTERIES;CATHODES;DEPOLARIZATION;SEMICONDUCTOR MATERIALS;SILVER;CATALYSTS;COPPER OXIDES; POLARIZATION;PERFORMANCE;DESIGN;FABRICATION

3544 IRON ELECTRODE. Giles, R.D. (to International Nickel Co., Inc.). US Patent 3,898,098. 5 Aug 1975. Priority date 21 Jun 1971, United Kingdom of Great Britain and Northern Ireland (UK). 5p.
A method for preparing electrodes for use as iron--nickel battery anodes is described. The active mass is electrodeposited from an aqueous electrolyte. (RWR)

3545 HYDROPHILIC ELECTRODE. Baker, B.S.; Klein, M.G. (to Energy Research Corp.). US Patent 3,898,099. 5 Aug 1975. Filed date 18 Mar 1974. 5p.
A mixture of powdered poly(tetrafluoroethylene) and active material is formed into the electrode; the poly(tetrafluoroethylene) comprises at most 3% of the mixture. (RWR)

3546 INVESTIGATION OF INTERACTION BETWEEN SILVER OXIDE ELECTRODE AND HYDRATED CELLULOSE FILM SEPARATOR IN SILVER-CADMIUM ACCUMULATORS. Molotkova, E.N.; Yarochkina, E.N. Zh. Prikl. Khim.; 48: No. 8, 1773-1778(Aug 1975). (In Russian).
For English translation see the journal J. Appl. Chem. USSR.
The oxidation--reduction interaction of the oxide electrode with hydrocellulose film during storage of charged silver--cadmium accumulators is discussed. It was demonstrated that accumulator electric characteristics during storage are linearly dependent on the capacity of this hydrocellulose film to interact with silver oxide: the more silver is absorbed by the film, the quicker is the decrease of the electromotive force and capacity of the accumulators. Preservation of the silver

electrode capacity in the silver--cadmium accumulators is determined first of all by the properties of the hydrocellulose separation film, and especially by the film layer adjacent to the positive electrode. The more inert the film layer is, with respect to silver oxide in the electrolyte, the slower is the dissolution of the electrode; and also the slower the decomposing speed of AgO, the longer the accumulator lasts.

3547 ANALYSIS OF POROUS ALKALINE CD-ELECTRODES. IV. OPTIMIZATION OF CURRENT EFFICIENCY. Selanger, P. (Lund Inst of Technol, Swed). J. Appl. Electrochem.; 5: No. 3, 255-262(Aug 1975).
Optimization of the electrode thickness, porosity and amount of active material necessary for a defined electrode polarization is carried out with a mathematical model on porous Cd electrodes. Three different problems were formulated for a constant current-load and a specified final total polarization in order to maximize the utilization of active materials. The results obtained show that the best high rate electrodes (100 mA cm$sup -2$) are high porosity electrodes with the half-width thickness in the interval of 0.10-0.18 cm depending on the formulated optimization problems. This work has application to electric batteries. 5 refs.

3548 ENCASING THE ACTIVE MASSES OF A LEAD STORAGE BATTERY. Metzler, O. German(FRG) Patent 2,403,379. 31 Jul 1975. Filed date 24 Jan 1974. 10p.
LEAD-ACID BATTERIES;ELECTRODES;PLASTICS; COVERINGS;SINTERING

3549 CARRYING OUT REACTIONS BETWEEN POWDERED AND GASEOUS MATERIALS. Czerny, T.; Von Doehren, H.; Loesch, L.; Winsel, A.; Ziegler, K. (to Koenigswarter und Ebell Chemische Fabrik GmbH). German(FRG) Patent 2,403,998. 31 Jul 1975. Filed date 29 Jan 1974. 15p.
Patent; means for chemical preparation of active materials. GASES;POWDERS;CHEMICAL REACTIONS;COUNTER CURRENT;CATALYSTS;CHEMICAL PREPARATION;ELECTRIC BATTERIES;ELECTRODES; NICKEL-CADMIUM BATTERIES;CATHODES;NICKEL;NICKEL HYDROXIDES

3550 HYBRID ELECTRODES FOR METAL--AIR CELLS. Siemsen, G. (to Siemens AG). German(FRG) Patent 2,404,444. 31 Jul 1975. Filed date 30 Jan 1974. 17p.
METAL-GAS BATTERIES;AIR;CATHODES;DESIGN; LAYERS;NICKEL;PLASTICS;CARBON

3551 STORAGE BATTERY FOR VEHICLES. Sakamoto, A. (to Daiden Co., Inc., Fukuoka, Japan). US Patent 3,895,964. 22 Jul 1975. Filed date 18 Jul 1973. 4p.
Patent; colored float indicates level or specific gravity of electrolyte. VEHICLES;LEAD-ACID BATTERIES;ELECTROLYTES;LEVEL INDICATORS; DESIGN;CLOSURES

3552 DIFFUSION-BONDED BATTERY ELECTRODE PLAQUES. Brown, J.T.; Feduska, W.; Bradford, W.L. (to Westinghouse Electric Corp., Pittsburgh, PA). US Patent 3,895,960. 22 Jul 1975. Filed date 27 Aug 1970. 6p.
HYDROXIDES;ELECTRIC BATTERIES;SILVER-ZINC BATTERIES;SILVER-CADMIUM BATTERIES;IRON-NICKEL BATTERIES;NICKEL-CADMIUM BATTERIES;BONDING; DIFFUSION;FIBERS;FABRICATION;ELECTRODES

3553 DIFFUSION-BONDED BATTERY ELECTRODE PLAQUES. Brown, J.T.; Feduska, W.; Bradford, W.L. (to Westinghouse Electric Corp.). US Patent 3,895,960. 22 Jul 1975. Filed date 27 Aug 1970. 5p.
Patent; steel fibers. IRON;STEELS;FIBERS; ELECTRODES;NICKEL;COATINGS;BONDING;ELECTRIC BATTERIES

3554 ELECTRIC CIRCUITS PARTICULARLY FOR AUTOMATIC BATTERY CHARGING APPARATUS. Foster, G.W.; Clayton, D.A. (to Electric Power Storage Ltd., London, England). US Patent 3,895,282. 15 Jul 1975. Filed date 26 Dec 1973. 12p.
BATTERY CHARGERS;ELECTRONIC CIRCUITS; ELECTRIC POTENTIAL

3555 METHOD OF MAKING SEPARATORS FOR ALKALINE BATTERIES. Gillman, L.M.; Stark, R.E. (to Gates Rubber Co., Denver, CO). US Patent 3,894,889. 15 Jul 1975. Filed date 17 Sep 1973. 8p.
HYDROXIDES;BATTERY SEPARATORS;LAYERS; FABRICATION;NICKEL-CADMIUM BATTERIES;NICKEL-ZINC BATTERIES;SILVER-ZINC BATTERIES;ZINC-MANGANESE BATTERIES;CELLOPHANE

3556 APPARATUS FOR PASTING BATTERY PLATES. Pankow, H.G.; Larkin, T.M.; Young, R.L.; McClelland, D.H. (to Gates Rubber Co., Denver, CO). US Patent 3,894,886. 15 Jul 1975. Filed date 7 Feb 1974. 8p.
LEAD-ACID BATTERIES;PLATES;GRIDS;FABRICATION; EQUIPMENT

3557 ACTIVATION OF NICKEL BATTERY PLATES. Turner, T.S.; Whittle, J.E. (to International Nickel Co., Inc., New York). US Patent 3,894,885. 15 Jul 1975. Filed date 2 Mar 1973. 4p.
Patent; electrolytic process. NICKEL-CADMIUM BATTERIES;NICKEL-ZINC BATTERIES;IRON-NICKEL BATTERIES;CATHODES;ELECTRIC BATTERIES;NICKEL; PLATES;CHEMICAL ACTIVATION;FOILS;HYDROXIDES; NICKEL COMPOUNDS;AMMONIA;AMMONIUM COMPOUNDS; NITRATES;NICKEL NITRATES

3558 APPARATUS FOR DETERMINING THE STATE OF CHARGE OF STORAGE BATTERIES. Schweizer, W.; Reissland, M.-U. (to VDO Adolf Schindling AG, Germany). US Patent 3,895,284. 15 Jul 1975. Filed date 2 Jul 1974. 8p.
ELECTRIC BATTERIES;LEAD-ACID BATTERIES; ELECTRONIC EQUIPMENT;ELECTRIC MEASURING INSTRUMENTS;OPERATION

3559 FORMING AND PLACING TUBULAR BATTERY SEPARATORS. Beckman, M.H. (to ESB Inc.). Canadian Patent 971,222. 15 Jul 1975. Filed date 26 Feb 1973. 11p.
Patent; machine for manufacture. TUBES; BATTERY SEPARATORS;FABRICATION;EQUIPMENT

3560 TEMPERATURE RESPONSIVE BATTERY CHARGING CIRCUIT. Peterson, B.E. (to Vapor Corp.). US Patent 3,895,283. 15 Jul 1975. Filed date 26 Nov 1973. 8p.
A battery charging circuit for use in aircraft is described wherein a voltage-regulated alternator is employed to maintain a nickel--cadmium battery charged. A temperature-dependent resistance element thermally coupled to the battery provides a reference voltage against which battery terminal voltage is compared. When the terminal voltage falls below

the reference voltage, application of sensing voltage to the alternator voltage regulator is interrupted; this interruption causes full charging current to be applied to the battery. When the terminal voltage exceeds the reference voltage, sensing voltage is reapplied to reduce charging current. The alternator switches between maximum and minimum charging efforts to maintain a voltage level dictated by the battery temperature. 3 figures. (auth)

3561 SEPARATORS FOR ALKALINE BATTERIES. Gillman, L.M.; Stark, R.E. (to Gates Rubber Co.). US Patent 3,894,889. 15 Jul 1975. Filed date 3 Aug 1970. 6p.
This separator consists of a number of layers held together with a gelling agent. Nickel--zinc batteries made with these separators showed a distinct improvement in cycle life. (RWR)

3562 LEAD CHLORIDE ELECTRODE. Coleman, J.R.; Humphreys, W.G. (to Canada, Minister of National Defence). Canadian Patent 970,826. 8 Jul 1975. Filed date 7 Dec 1971. 17p.
Patent; $PbCl_2$ + graphite with formaldehyde--urea polymer binder and metal grid. LEAD CHLORIDES;CATHODES;ELECTRIC BATTERIES;GRAPHITE; FORMALDEHYDE;UREA;COPPER;SILVER;NICKEL

3563 PHENOLIC RESIN AND BATTERY SEPARATOR IMPREGNATED WITH IT. Jones, R.T. (to Monsanto Co.). US Patent 3,893,871. 8 Jul 1975. Filed date 9 Jan 1974. 5p.
RESINS;PHENOL;BATTERY SEPARATORS;CELLULOSE; RESORCINOL;CHEMICAL PREPARATION

3564 SEPARATOR FOR AN ALKALINE BATTERY. Ito, H. (to Teikoku Oil Co., Ltd.). Japanese Patent 19,324. 5 Jul 1975. Filed date 17 Sep 1970. 2p.
BATTERY SEPARATORS;ELECTRIC BATTERIES; HYDROXIDES;CHEMICAL PREPARATION;DRYING; OXIDATION;PVA

3565 SEALED TYPE ALKALINE STORAGE BATTERY. Ozeki, M.; Kuraki, J.; Yasuda, K. (to Matsushita Electric Industrial Co., Ltd.). Japanese Patent 19,323. 5 Jul 1975. Filed date 14 Dec 1970. 3p.
Patent; improved Ni hydroxide cathode containing $Ba(OH)_2$. HYDROXIDES;ELECTRIC BATTERIES;SEALS;NICKEL-CADMIUM BATTERIES;NICKEL-ZINC BATTERIES;IRON-NICKEL BATTERIES;CATHODES; BARIUM HYDROXIDES;NICKEL HYDROXIDES

3566 GRID PLATES FOR LEAD STORAGE BATTERIES. Tsuda, N. (to Furukawa Electric Co., Ltd.). German(FRG) Patent 2,461,199. 3 Jul 1975. Filed date 26 Dec 1973. 54p.
Patent; fabrication. LEAD-ACID BATTERIES; GRIDS;PLATES;FABRICATION

3567 STORAGE BATTERY WITH SINGLE FILL VALVE. Bell, J.E.; Laczko, R.P. (to ESB Inc., Philadelphia, PA). US Patent 3,892,595. 1 Jul 1975. Filed date 5 Apr 1974. 6p.
LEAD-ACID BATTERIES;VALVES;DESIGN

3568 ALKALINE CELLS. Ieki, M.; Inoue, K.; Shimizu, T. (to Matsushita Electric Industrial Co., Ltd., Osaka, Japan). US Patent 3,892,593. 1 Jul 1975. Filed date 5 Jun 1973. 8p.
Patent; halogenated butyl rubber with blended styrenic and phenolic resins. HYDROXIDES;ELECTRIC BATTERIES;ZINC-MANGANESE BATTERIES;LEAKS;GASKETS;RESINS;DIELECTRIC MATERIALS;NICKEL-CADMIUM BATTERIES;RUBBERS; ORGANIC HALOGEN COMPOUNDS

3569 CATHODE MATERIAL FOR USE IN NONAQUEOUS ELECTROLYTES. Gunther, R.G. (to Yardney International Corp.). US Patent 3,892,590. 1 Jul 1975. Filed date 16 Jul 1973. 4p.
Patent; fluorinated graphite. ELECTRIC BATTERIES;GRAPHITE;LITHIUM;CATHODES;FLUORINATED ALIPHATIC HYDROCARBONS

3570 ANODIC PASSIVATION BY ''CDO'' STUDIED BY ESR. Casey, E.J.; Gardner, C.L. (Def Res Establ, Ottawa, Ont). J. Electrochem. Soc.; 122: No. 7, 851-854(Jul 1975).
The evidence for a form of cadmium oxide as the instrument of anodic passivation of cadmium in aqueous KOH from 33 to -40 C is reviewed, and some new evidence obtained via ESR is added and interpreted. The mechanism by which the metal ceases to be anodically oxidizable after a period of active oxidation is one important element of the information needed if more efficient utilization of the metal in negative plates of alkaline batteries is to be achieved. The results reported can be considered as relevant to the mechanisms operating at the cadmium electrode of a cadmium-alkali cell which has been driven into cell reversal at low temperatures. Attack of cell components by anodically produced free radicals, which are mobile in the electrolyte, can be anticipated. This work has application to alkaline batteries.

3571 LOW-RATE CATHODIC LINEAR SWEEP VOLTAMMETRY (LSV) STUDIES ON ANODIZED LEAD. Sharpe, T.F. (General Motors, Warren, MI). J. Electrochem. Soc.; 122: No. 7, 845-851(Jul 1975).
The sweeps were supplemented by current-time traces obtained during the short-term anodic treatment above the $PbO_2$-$PbSO_4$ reversible potential in $H_2SO_4$ electrolytes. Despite complications from additional substrate corrosion during the sweeps, semiquantitative observations were possible and the cathodic discharge could be resolved into $\alpha$ and $\beta$-$PbO_2$ components. A major finding was that antimony in the lead retards the formation of $\beta$-$PbO_2$ in the preliminary anodic treatment. Implications from the results with regard to the behavior of the Pb--acid battery positive plate are briefly discussed.

3572 SOME PROPERTIES OF ELECTRODEPOSITED LEAD DIOXIDE. Smith, J.F. (Armament Research and Development Establishment, Kent, Eng.). Trans. Inst. Met. Finish.; 53: 83-88(Sum 1975).
The results of research on the adhesion of electrodeposited lead dioxide to nickel substrates and the electrical performance of this material when used as a battery plate are cited. It was found that, when lead dioxide is plated onto electrodeposited nickel prepared from a nickel chloride electrolyte, adherent coatings are obtained; nonadherent coatings of lead dioxide are obtained when deposits are made on nickel substrates prepared from all other electrolytes. An explanation is offered for this phenomenon. It is also shown that intrinsic stress in electrodeposited lead dioxide plays an important role in its voltage performance when discharged against lead in a fluoroboric acid electrolyte.

3573 TWO-LAYER CASING FOR TUBULAR ELECTRODES FOR STORAGE BATTERIES. Sundberg, E.G.; Westberg, E. (to Aktiebolag Tudor). German(FRG) Patent 2,459,999. 26 Jun 1975. Filed date 17 Dec 1973. 18p.
ELECTRIC BATTERIES;TUBES;ELECTRODES;GLASS; FIBERS;POLYOLEFINS;COVERINGS;LEAD-ACID BATTERIES;DESIGN

3574 PLATE GRID FOR LEAD STORAGE BATTERIES. Brinkmann, J.; Trippe, G.; Heissmann, W. (to Varta Batterie AG). German(FRG) Patent 2,363,759. 26 Jun 1975. Filed date 21 Dec 1973. 15p.
LEAD-ACID BATTERIES;GRIDS;PLATES;RODS;DESIGN

3575 ELECTROCHEMICALLY ACTIVE CADMIUM COMPOSITION FOR BATTERY ELEMENTS. Ness, P.; Von Doehren, H.; Schroeder, H. (to Varta Batterie AG). German(FRG) Patent 2,361,905. 26 Jun 1975. Filed date 13 Dec 1973. 8p.
CADMIUM ALLOYS;NICKEL ALLOYS;CHEMICAL PREPARATION;ANODES;NICKEL-CADMIUM BATTERIES; SILVER-CADMIUM BATTERIES

3576 ELECTROCHEMICALLY ACTIVE CADMIUM MASS FOR GALVANIC ELEMENTS. Ness, P.; von Doehren, H.; Schroeder, H. (to Varta AG). German(FRG) Patent 2,361,905/A/. 26 Jun 1975. 7p. (In German).
The invention is based on the task of making an electrochemically active cadmium mass which can be used as active mass and as discharge reserve in the production of negative electrodes for nickel--cadmium batteries. According to the invention, this problem is solved in that the electrochemically active mass is an intermetallic compound of cadmium and nickel of the type of the 'Hume-Rothery' phase.

3577 GAS ELECTRODE. Wright, M.L. (to Lucas, Joseph, (Industries) Ltd.). British Patent 1,398,843. 25 Jun 1975. Filed date 10 Jul 1971. 3p.
Patent; metal--air battery with gelled KOH electrolyte. METAL-GAS BATTERIES;AIR;POTASSIUM HYDROXIDES;ELECTRODES;CARBON;AQUEOUS SOLUTIONS; PVA;COATINGS;CARBOXYLIC ACIDS;AMIDES;AMINES; CATHODES

3578 CADMIUM FIBERS AND GALVANIC CELL ANODES MADE FROM THEM. Louzos, D.V. (to Union Carbide Corp.). Canadian Patent 970,029. 24 Jun 1975. Filed date 3 Apr 1970. 24p.
Patent; prepared by electrolysis of electrolyte of Cd salt. ELECTRIC BATTERIES; HYDROXIDES;NICKEL-CADMIUM BATTERIES;ANODES; CADMIUM;FIBERS;FABRICATION;ELECTROLYSIS;MOLDING

3579 APPARATUS AND METHOD FOR PREPARING GRID PLATES FOR LEAD STORAGE BATTERIES. Sassmannshausen, G. (to Accumulatorenwerk Hoppecke Carl Zoellner und Sohn). German(FRG) Patent 2,360,574. 19 Jun 1975. Filed date 5 Dec 1973. 14p.
LEAD-ACID BATTERIES;GRIDS;PLATES;FABRICATION; CHEMICAL PREPARATION;LEAD;LEAD OXIDES;WATER; MIXING;EXTRUSION;SULFURIC ACID;HETEROCYCLIC COMPOUNDS;OXYGEN COMPOUNDS

3580 FORMING A HIGH SURFACE AREA METALLIC CADMIUM POWDER AND AN ELECTRODE THEREFROM. Thornton, R.F. (to General Electric Co.). US Patent 3,890,159. 17 Jun 1975. Filed date 4 Dec 1972. 4p.
NICKEL-CADMIUM BATTERIES;SILVER-CADMIUM BATTERIES;ANODES;CADMIUM;POWDERS;CADMIUM OXIDES; ZINC;POTASSIUM HYDROXIDES;FABRICATION

3581 LEAD ALLOY FOR PRODUCING ATTENTION-FREE LEAD--ACID BATTERIES. Mao, G.W.; Lannoye, W.J. (to Gould, Inc.). German(FRG) Patent 2,457,349. 12 Jun 1975. Filed date 5 Dec 1974. 20p.
LEAD-ACID BATTERIES;LEAD BASE ALLOYS;GRIDS; ANTIMONY ALLOYS;CADMIUM ALLOYS;TENSILE PROPERTIES;YIELD STRENGTH;PERFORMANCE; FABRICATION

3582 RECHARGEABLE CELL HAVING IMPROVED CADMIUM NEGATIVE ELECTRODE AND METHOD OF PRODUCING SAME. Catherino, H.A. (to General Electric Co., Owensboro, KY). US Patent 3,888,695. 10 Jun 1975. Filed date 23 Nov 1973. 8p.
ELECTRIC BATTERIES;ANODES;SILVER-CADMIUM BATTERIES;NICKEL-CADMIUM BATTERIES;FABRICATION; CADMIUM;CADMIUM OXIDES;POWDERS

3583 CLAD-TYPE ELECTRODES FOR LEAD STORAGE BATTERIES. Kono, M.; Yasunaga, K. (to Yuasa Battery Co., Ltd.). Japanese Patent 69,525. 10 Jun 1975. Filed date 24 Oct 1973. 3p.
Patent; fabrication. LEAD-ACID BATTERIES; CATHODES;ELECTRODES;FABRICATION;LEAD;LEAD OXIDES;LEAD SULFATES;PERFORMANCE

3584 GEL-TYPE ZINC ANODE FOR ALKALINE BATTERIES. Tsuchida, T.; Shinoda, K.; Yamamoto, K.; Nishio, M.; Takase, T. (to Fuji Electric Co., Ltd.). Japanese Patent 67,427. 6 Jun 1975. Filed date 19 Oct 1973. 3p.
NICKEL-ZINC BATTERIES;SILVER-ZINC BATTERIES; ZINC-MANGANESE BATTERIES;ANODES;HYDROXIDES; FABRICATION;WATER;POTASSIUM HYDROXIDES;ZINC OXIDES;ZINC;MERCURY;CELLULOSE ESTERS;ZINC ALLOYS;MERCURY ALLOYS

3585 ZINC ELECTRODES FOR RECHARGEABLE BATTERIES. Forst, H.; Vielstich, W. German(FRG) Patent 2,360,026. 5 Jun 1975. Filed date 1 Dec 1973. 12p.
Patent; synthetic latex coating to prevent dendrite formation. NICKEL-ZINC BATTERIES; SILVER-ZINC BATTERIES;ZINC-MANGANESE BATTERIES; ANODES;ZINC;ELECTRODES;ELECTRIC BATTERIES; DENDRITES;LATEX;COATINGS;POLYSTYRENE;ACRYLATES; PERFORMANCE

3586 SEPARATOR FOR AN ALKALINE STORAGE BATTERY. Koval'chuk, P.I.; Artemov, V.V. (to Voroshilovgrad Plant of Alkaline Storage Batteries). USSR Patent 473,242. 5 Jun 1975. Filed date 25 Aug 1972.
BATTERY SEPARATORS;CHEMICAL COMPOSITION; DESIGN;HYDROXIDES;RESINS;ALUMINIUM OXIDES; CALCIUM COMPOUNDS;TITANATES

3587 CADMIUM ANODE FOR ALKALINE BATTERIES. Kanetsuki, K.; Okamoto, S.; Ogawa, H. (to Matsushita Electric Industrial Co., Ltd.). Japanese Patent 66,740. 5 Jun 1975. Filed date 17 Oct 1973. 3p.
ANODES;NICKEL-CADMIUM BATTERIES;FABRICATION; CADMIUM OXIDES;PVA;GLYCOLS;CADMIUM NITRATES; POTASSIUM HYDROXIDES;CHEMICAL PREPARATION; SILVER-CADMIUM BATTERIES

3588 NICKEL OR CADMIUM ELECTRODES FOR ALKALINE CELLS. Tadara, Y.; Yamaga, M.; Ogawa, H. (to Matsushita Electric Industrial Co., Ltd.). Japanese Patent 66,744. 5 Jun

1975. Filed date 18 Oct 1973. 4p.
Patent; chemical preparation. HYDROXIDES; NICKEL;CADMIUM;SINTERED MATERIALS;PLATES;NICKEL NITRATES;CADMIUM NITRATES;CHEMICAL PREPARATION; ANODES;SILVER-CADMIUM BATTERIES;NICKEL-ZINC BATTERIES;IRON-NICKEL BATTERIES;CATHODES; ELECTRODES;ELECTRIC BATTERIES;NICKEL-CADMIUM BATTERIES

3589 BATTERY ELECTRODE SUPPORT. Okami, K.; Yamaga, M.; Ogawa, H. (to Matsushita Electric Industrial Co., Ltd.). Japanese Patent 66,743. 5 Jun 1975. Filed date 18 Oct 1973. 3p.
NICKEL;SUPPORTS;SOLS;GELS;POWDERS; DISPERSIONS;SINTERING;FABRICATION;AGAR;WATER; MEDIUM TEMPERATURE;CARBONYLS;PLATES;NICKEL COMPOUNDS;ELECTRIC BATTERIES;ELECTRODES; CATHODES;NICKEL-CADMIUM BATTERIES;NICKEL-ZINC BATTERIES;IRON-NICKEL BATTERIES

3590 BATTERY ELECTRODE SUPPORTS. Okami, K.; Yamaga, M.; Ogawa, H. (to Matsushita Electric Industrial Co., Ltd.). Japanese Patent 66,741. 5 Jun 1975. Filed date 17 Oct 1973. 4p.
NICKEL;SUPPORTS;POWDERS;FABRICATION; CARBONYLS;CELLULOSE;WATER;SINTERING;NICKEL HYDROXIDES;NICKEL COMPOUNDS;CATHODES;NICKEL-CADMIUM BATTERIES;NICKEL-ZINC BATTERIES;IRON-NICKEL BATTERIES;ELECTRIC BATTERIES;ELECTRODES

3591 ELECTRODE PLATE OF ALKALINE STORAGE BATTERY. Ogawa, H.; Kanetsuku, K.; Yamaga, M. (to Matsushita Electric Industrial Co., Ltd.). Japanese Patent 15,288. 4 Jun 1975. Filed date 30 Sep 1970. 6p.
Patent; preparation of Ni or Cd electrode. PLATES;HYDROXIDES;CHEMICAL PREPARATION; ELECTRODES;NICKEL-CADMIUM BATTERIES;SILVER-CADMIUM BATTERIES;NICKEL-ZINC BATTERIES;IRON-NICKEL BATTERIES;ELECTRIC BATTERIES;NICKEL; CADMIUM

3592 ANODE OF LEAD STORAGE BATTERY. Sekido, S.; Fukuda, S. (to Matsushita Electric Industrial Co., Ltd.). Japanese Patent 15,283. 4 Jun 1975. Filed date 22 Sep 1970. 5p.
LEAD-ACID BATTERIES;ANODES;FABRICATION;LEAD; POWDERS;BARIUM SULFATES;EXTRUSION;ANODIZATION

3593 ELECTRODE OF LEAD STORAGE BATTERY. Tsubota, T. (to Japan Storage Battery Co., Ltd.). Japanese Patent 15,287. 4 Jun 1975. Filed date 11 Dec 1970. 3p.
LEAD-ACID BATTERIES;ELECTRIC-POWERED VEHICLES;ELECTRODES;CHEMICAL PREPARATION;LEAD NITRATES;ACTIVATED CARBON;LEAD;LEAD OXIDES

3594 LEAD STORAGE BATTERY. Inoue, K. (to Inoue Japax Res. Inst.). Japanese Patent 64,738. 2 Jun 1975. Filed date 11 Oct 1973. 2p.
Patent; electrode fabrication. LEAD-ACID BATTERIES;CATHODES;ELECTRODEPOSITION; FABRICATION

3595 AIR ELECTRODE. Molodtsova, N.I.; Reznikov, G.L.; Yuppets, F.R. USSR Patent 472,403. 30 May 1975. Filed date 13 Jul 1973.
Patent; preparation. METAL-GAS BATTERIES; ZINC-AIR BATTERIES;AIR;CATHODES;FABRICATION; POLYETHYLENES;CATALYSTS;HEAT TREATMENTS; ALUMINIUM OXIDES

3596 CATALYTIC OXIDATION REACTOR FOR HYDROGEN OR OTHER FUEL GAS IN AN OXYGEN-CONTAINING GAS MIXTURE. Winsel, A.; Laig-Hoerstebrock, H. (to Varta Batterie AG). German(FRG) Patent 2,357,631. 28 May 1975. Filed date 19 Nov 1973. 9p.
ELECTRIC BATTERIES;GASES;HYDROGEN;OXIDATION; DESIGN;COOLING

3597 GAS ELECTRODE. Kori, Y. (to Hitachi Maxell, Ltd.). Japanese Patent 14,327. 27 May 1975. Filed date 4 Aug 1970. 2p.
FUEL CELLS;METAL-GAS BATTERIES;ELECTRODES; POLYMERS;CATALYSTS;CHEMICAL PREPARATION

3598 NICKEL CATHODES FOR ALKALINE BATTERIES. Kaneda, Y.; Naito, M.; Ohyama, K. (to Ray-O-Vac Co. (Japan), Ltd.). Japanese Patent 61,635. 27 May 1975. Filed date 4 Oct 1973. 3p.
NICKEL;CATHODES;HYDROXIDES;POWDERS;RESINS; FABRICATION;NICKEL HYDROXIDES;GRAPHITE; POLYSTYRENE;CEMENTS;POTASSIUM HYDROXIDES; POLYAMIDES;NICKEL-ZINC BATTERIES;IRON-NICKEL BATTERIES;NICKEL-CADMIUM BATTERIES;ELECTRIC BATTERIES

3599 ANODE OF ALKALINE STORAGE BATTERY. Ozeki, M. (to Matsushita Electric Industrial Co., Ltd.). Japanese Patent 14,324. 27 May 1975. Filed date 26 Mar 1970. 2p.
Patent; Cd with 1 to 5 percent of a nitrate. ANODES;NICKEL-CADMIUM BATTERIES;NITRATES; TENSILE PROPERTIES

3600 SINTERED ELECTRODE PLATE FOR ALKALINE STORAGE BATTERY. Kudara, Y.; Yamaga, M.; Ogawa, H.; Oda, S. (to Matsushita Electric Industrial Co., Ltd.). Japanese Patent 59,743. 23 May 1975. Filed date 26 Sep 1973. 4p.
Patent; fabrication. ELECTRODES;SINTERED MATERIALS;PLATES;HYDROXIDES;ELECTRIC BATTERIES; FABRICATION;NICKEL;POTASSIUM HYDROXIDES;NICKEL-CADMIUM BATTERIES;NICKEL-ZINC BATTERIES;IRON-NICKEL BATTERIES;NICKEL-HYDROGEN BATTERIES

3601 SODIUM BORATE GLASS COMPOSITIONS FOR REVERSIBLE BATTERIES. Tsang, F.Y. (to Dow Chemical Co.). French Patent 2,249,042. 23 May 1975. Filed date 25 Oct 1973. 11p.
Membranes for use as battery separators made from amorphous sodium borate and sodium halide glass are discussed. Preferably, they consist of hollow, fine fibers with od's of 20 to 1000 μm and wall thicknesses of 5 to 100 μm. Various additives to modify the properties of the glass may also be present. (RWR)

3602 SEPARATOR FOR A STORAGE BATTERY. Bonnefont, J. (to Compagnie Europeenne d'Accumulateurs). German(FRG) Patent 2,454,824. 22 May 1975. Filed date 21 Nov 1973. 8p.
LEAD-ACID BATTERIES;BATTERY SEPARATORS;FOILS; FABRICATION

3603 SEPARATORS FOR LEAD STORAGE BATTERIES. Ito, T.; Ohtomo, K. (to Kanebo, Ltd.). Japanese Patent 58,537. 21 May 1975. Filed date 22 Sep 1973. 5p.
LEAD-ACID BATTERIES;BATTERY SEPARATORS; FABRICATION;THERMOPLASTICS;RESINS;POLYESTERS; POLYOLEFINS;POLYACRYLATES;HOT PRESSING; PERFORMANCE

3604 ANODE FOR GALVANIC CELLS. Tucholski, G.R. (to Union Carbide Corp.). US Patent 3,884,721. 20 May 1975. Filed date 18 Mar 1974. 10p.
Patent; gas-permeable matrix of cross-linked polyacrylamide saturated with electrolyte and incorporating Zn particles. ANODES;ZINC;ZINC OXIDES;MERCURY OXIDES;POTASSIUM HYDROXIDES; FABRICATION;PERFORMANCE;COMPARATIVE EVALUATIONS; CORROSION;POLYAMIDES;NICKEL-ZINC BATTERIES; SILVER-ZINC BATTERIES;ZINC-MANGANESE BATTERIES; ELECTRIC BATTERIES;CROSS-LINKING

3605 STORAGE BATTERY PLATE HAVING A CORE OF ALUMINIUM. Walker, H.D. US Patent 3,884,716. 20 May 1975. Filed date 11 Dec 1972. 3p.
LEAD-ACID BATTERIES;PLATES;ELECTRODES; ALUMINIUM;SILVER;LEAD;ZINC;PLATING;FABRICATION

3606 POROUS CADMIUM METAL FOR ALKALINE STORAGE BATTERIES. Morioka, Y. (to Sanyo Electric Co., Ltd.). Japanese Patent 56,542. 17 May 1975. Filed date 20 Sep 1973. 2p.
Patent; Cd powder + urea heated and washed. FABRICATION;CADMIUM;POWDERS;UREA;BINDERS;WATER; SLURRIES;TENSILE PROPERTIES;ELECTRIC BATTERIES; ELECTRODES;NICKEL-CADMIUM BATTERIES;SILVER-CADMIUM BATTERIES;ANODES

3607 ELECTRODES FOR STORAGE BATTERIES. Sako, H. (to Sanyo Electric Co., Ltd.). Japanese Patent 56,540. 17 May 1975. Filed date 19 Sep 1973. 2p.
Patent; treatment with $H_2O_2$ for improved storage stability. NICKEL-CADMIUM BATTERIES; ELECTRODES;HYDROXIDES;HYDROGEN PEROXIDE; NITRATES;IONS;STORAGE;ELECTROCHEMISTRY;CHEMICAL REACTIONS

3608 ANODES FOR ALKALINE STORAGE BATTERIES. Morioka, Y. (to Sanyo Electric Co., Ltd.). Japanese Patent 55,844. 16 May 1975. Filed date 17 Sep 1973. 3p.
Patent; 165 mAh/g, 700 mAh/cm$^3$. ANODES; ELECTRIC BATTERIES;SILVER-CADMIUM BATTERIES; NICKEL-CADMIUM BATTERIES;CADMIUM;HYDROXIDES; SINTERED MATERIALS;ANODIZATION;POWDERS;POLYMERS; FABRICATION;SODIUM PHOSPHATES;POTASSIUM CARBONATES;SODIUM COMPOUNDS;ACETATES

3609 MOLDED CATALYST BODY FOR STORAGE BATTERIES. Tsubuki, A. (to Furukawa Battery Co., Ltd.). Japanese Patent 55,841. 16 May 1975. Filed date 19 Sep 1973. 2p.
LEAD-ACID BATTERIES;ELECTRIC BATTERIES; CONTAINERS;CATALYSTS;RESINS;GASES;HYDROGEN; OXYGEN;WATER;CHEMICAL REACTIONS;CARBON;POWDERS; PALLADIUM;TEFLON;CYLINDERS;ALUMINIUM OXIDES

3610 POSITIVE ELECTRODES FOR LEAD STORAGE BATTERIES. Eriksson, T. (to Aktiebolag). German(FRG) Patent 2,451,970. 15 May 1975. Filed date 1 Nov 1973. 12p.
LEAD-ACID BATTERIES;CATHODES;CHEMICAL PREPARATION;SODIUM SULFATES;SODIUM HYDROXIDES

3611 MIXTURE CONTAINING POWDERED LEAD, LEAD OXIDE, AND A PORE-FORMING ADDITIVE, FOR PREPARING ELECTRODES FOR LEAD STORAGE BATTERIES. Eriksson, T. (to Aktiebolag Tudor). German(FRG) Patent 2,451,964. 15 May 1975. Filed date 1 Nov 1973. 13p.
LEAD-ACID BATTERIES;LEAD;LEAD OXIDES; MAGNESIUM OXIDES;MAGNESIUM CARBONATES;MAGNESIUM PHOSPHATES;MAGNESIUM SULFATES;MIXTURES;POWDERS; ELECTRODES;FABRICATION;ELECTRIC BATTERIES

3612 PERFORATED SUBSTRATE FOR PRESSED BATTERY PLATES. Sugalski, R.K. (to General Electric Co.). German(FRG) Patent 2,452,544. 15 May 1975. Filed date 7 Nov 1973. 12p.
ELECTRIC BATTERIES;PLATES;FABRICATION;NICKEL; STEELS;PLATING;ELECTRODES;SUBSTRATES

3613 ELECTRODES FOR ALKALINE BATTERIES. Gutridge, I.P. (to International Nickel Ltd.). German(FRG) Patent 2,453,581. 15 May 1975. Filed date 13 Nov 1973. 13p.
Patent; preparation. IRON-NICKEL BATTERIES; NICKEL-CADMIUM BATTERIES;NICKEL-ZINC BATTERIES; CATHODES;AQUEOUS SOLUTIONS;BASES;ELECTRIC BATTERIES;ELECTRODES;NICKEL HYDROXIDES;CHEMICAL PREPARATION

3614 ALKALINE MANGANESE BATTERY. Sadamura, A.; Nabe, R. (to Matsushita Electric Industrial Co., Ltd.). Japanese Patent 54,840. 14 May 1975. Filed date 14 Sep 1973. 2p.
ZINC-MANGANESE BATTERIES;HYDROXIDES; MANGANESE;CATHODES;MIXTURES;MANGANESE OXIDES; CARBON;POTASSIUM HYDROXIDES;ELECTRIC BATTERIES; FABRICATION;PERFORMANCE

3615 IRON ELECTRODE FOR AN ALKALINE BATTERY. Mitsumata, T.; Mori, M.; Iwaki, T.; Fukuda, M. (to Agency of Industrial Sciences and Technology). Japanese Patent 54,846. 14 May 1975. Filed date 14 Sep 1973. 3p.
Patent; Fe/air batteries, electrode fabrication. IRON-NICKEL BATTERIES;ANODES; CHEMICAL PREPARATION;IRON;AIR;METAL-GAS BATTERIES;PERFORMANCE

3616 SODIUM--SULFUR STORAGE BATTERY. Chiku, T.; Kogiso, T.; Kojima, K.; Yoshida, T. (to Toyota Central Research and Development Labs., Inc.). US Patent 3,883,367. 13 May 1975. Filed date 19 Oct 1972. 11p.
SODIUM-SULFUR BATTERIES;CATHODES;FIBERS; GRAPHITE;SODIUM SULFIDES;PERFORMANCE

3617 ANODE FOR NICKEL--CADMIUM BATTERIES. Ohhoshi, T.; Yokota, Y. (to Sony Corp.). Japanese Patent 53,842. 13 May 1975. Filed date 13 Sep 1973. 2p.
Patent; Ni-plated nylon fabric coated with $H_2O$, CdO dextrose, and ethylene glycol. NICKEL-CADMIUM BATTERIES;ANODES;FABRICATION;NYLON; TEXTILES;SUPPORTS;CADMIUM OXIDES;WATER;GLUCOSE; GLYCOLS

3618 CADMIUM ANODE FOR ALKALINE STORAGE BATTERIES. Kurihara, K. (to Furukawa Electric Co., Ltd.). Japanese Patent 52,543. 10 May 1975. Filed date 19 May 1973. 3p.
Patent; fabrication. NICKEL-CADMIUM BATTERIES;ANODES;FABRICATION;CADMIUM OXIDES; OXYGEN COMPOUNDS;HETEROCYCLIC COMPOUNDS;ORGANIC POLYMERS;GLYCOLS;HYDROXIDES;PERFORMANCE; SINTERED MATERIALS;COMPARATIVE EVALUATIONS; SILVER-CADMIUM BATTERIES;CADMIUM;ELECTRIC BATTERIES

3619 NICKEL ELECTRODE FOR ALKALINE BATTERIES. Iwaki, T.; Mitsumata, T. (to Matsushita Electric Industrial Co., Ltd.). Japanese Patent 50,643. 7 May 1975. Filed date 7 Sep 1973. 4p.
Patent; preparation by polarizing Ni sponge in aqueous metal nitrate solution. NICKEL;

HYDROXIDES;FABRICATION;PVC;SODIUM HYDROXIDES; PERFORMANCE;CATHODES;NICKEL-CADMIUM BATTERIES; NICKEL-ZINC BATTERIES;IRON-NICKEL BATTERIES; NICKEL-HYDROGEN BATTERIES;ELECTRODES

3620 SODIUM BORATE--SODIUM HALIDE GLASS. Tsang, F.Y. (to Dow Chemical Co.). German(FRG) Patent 2,353,378. 7 May 1975. Filed date 25 Oct 1973. 15p.
SODIUM-SULFUR BATTERIES;BATTERY SEPARATORS; GLASS;FIBERS;CHEMICAL COMPOSITION

3621 CELL IS USED AS ENERGY SOURCE OF WRIST-WATCHES. Eliassaf, J. (to General Electric Co.). US Patent 3,881,661. 06 May 1975. Filed date 06 Dec 1973. 6p.
ALUMINIUM OXIDES;SUSPENSIONS;CHEMICAL PREPARATION;SODIUM-SULFUR BATTERIES;LITHIUM-SULFUR BATTERIES;METAL-NONMETAL BATTERIES; ELECTROLYTES

3622 LITHIUM ELECTRODE. McCoy, L.R. (to Rockwell International Corp.). US Patent 3,881,951. 6 May 1975. Filed date 5 Jul 1973. 7p.
Patent; fabrication, improved cycle life. LITHIUM-SULFUR BATTERIES;LITHIUM-CHLORINE BATTERIES;ANODES;FABRICATION;CHEMICAL PREPARATION;LITHIUM;ELECTRIC BATTERIES; ELECTRODES

3623 MASS FLOW RATE CONTROL OF CHLORINE CONTENT OF ELECTROLYTE FOR HIGH ENERGY DENSITY BATTERY. Carr, P.; Amato, C.J. (to Energy Development Associates). US Patent 3,881,958. 6 May 1975. Filed date 2 Jul 1973. 7p.
ZINC-CHLORINE BATTERIES;LITHIUM-CHLORINE BATTERIES;METAL-GAS BATTERIES;CHLORINE;MASS TRANSFER;FLOW RATE;ELECTROLYTES;LIQUID FLOW; PUMPS;FLOW REGULATORS

3624 BATTERY ELECTRODE GRIDS FROM A LEAD--CALCIUM--LITHIUM--TIN ALLOY. Turowski, L.E. (to St. Joe Minerals Corp.). US Patent 3,881,953. 6 May 1975. Filed date 26 Nov 1973. 3p.
Patent; fabrication. ELECTRODES;GRIDS;LEAD BASE ALLOYS;LITHIUM ADDITIONS;CALCIUM ADDITIONS; TIN ALLOYS;FABRICATION;LEAD-ACID BATTERIES

3625 LEAD DIOXIDE BATTERY PLATE. Maskalick, N.J. (to Westinghouse Electric Corp.). US Patent 3,881,954. 6 May 1975. Filed date 18 Mar 1974. 7p.
LEAD-ACID BATTERIES;CATHODES;PLATES;HIGH TEMPERATURE;OXIDATION;FABRICATION;CHEMICAL PREPARATION;LEAD OXIDES;LEAD SULFATES;SULFURIC ACID;ANODIZATION

3626 ALUMINIUM BATTERY CABLE. Yamaji, K.; Abe, H. (to Hitachi Cable, Ltd.). Japanese Patent 50,251. 6 May 1975. Filed date 4 Sep 1973. 3p.
LEAD-ACID BATTERIES;ELECTRIC CABLES; FABRICATION;ALUMINIUM;LEAD BASE ALLOYS;TIN ALLOYS;ZINC ALLOYS;CORROSION PROTECTION; COATINGS;ELECTRIC CONDUCTIVITY

3627 ZINC ALKALINE SECONDARY BATTERIES. Ikeda, H.; Furukawa, N.; Inoguchi, H.; Nishizawa, N. (to Agency of Industrial Sciences and Technology). Japanese Patent 65,832. 3 May 1975. Filed date 15 Oct 1973. 2p.
Patent; dendrite growth suppressed by In and Tl. HYDROXIDES;ZINC;ELECTRIC BATTERIES;SILVER-ZINC BATTERIES;NICKEL-ZINC BATTERIES;ZINC-MANGANESE BATTERIES;ZINC-AIR BATTERIES;ZINC-CHLORINE BATTERIES;ANODES;ADDITIVES;INDIUM; THALLIUM;DENDRITES;BATTERY CHARGING;INDIUM HYDROXIDES;THALLIUM OXIDES;POTASSIUM HYDROXIDES; ZINC OXIDES;LIFETIME;ELECTROLYTES

3628 CATHODE FOR A SILVER BATTERY. Sako, S. (to Yuasa Battery Co., Ltd.). Japanese Patent 11,569. 2 May 1975. Filed date 27 Jan 1969. 4p.
SILVER-CADMIUM BATTERIES;SILVER-ZINC BATTERIES;CATHODES;SILVER;SILVER OXIDES;POWDERS; PLASTICS;HEATING;SINTERING;ELECTRIC BATTERIES

3629 DETERIORATION IN CERAMIC ELECTROLYTES FOR SODIUM--SULFUR BATTERIES. Tennenhouse, G.J.; Ku, R.C.; Richman, R.H.; Whalen, T.J. (Ford Motor Co., Dearborn, MI). Am. Ceram. Soc. Bull.; 54: No. 5, 523-527; 531(May 1975). From 75. Annual meeting of the American Ceramic Society; Cincinnati, OH (1 May 1973).
CERAMICS;ELECTROLYTES;SODIUM-SULFUR BATTERIES;ALUMINIUM OXIDES;PERFORMANCE TESTING; FABRICATION

3630 ELECTRODE BEARING PLASTIC STRIP. Bilhorn, J.M. (to ESB Inc.). US Patent 3,880,669. 29 Apr 1975. Filed date 22 Apr 1974. 5p.
Patent; fabrication. ELECTRIC BATTERIES; ELECTRODES;FABRICATION

3631 WOUND-WIRE STORAGE BATTERY GRID. Wheadon, E.G.; McCartney, C.P., Jr. (to General Motors Corp.). Canadian Patent 966,898. 29 Apr 1975. Filed date 8 Sep 1970. 17p.
Patent; fabrication. LEAD-ACID BATTERIES; GRIDS;FABRICATION;LEAD ALLOYS

3632 LEAD STORAGE BATTERY. Matsuno, S.; Komori, F. (to Yuasa Battery Co., Ltd.). Japanese Patent 47,135. 26 Apr 1975. Filed date 6 Aug 1974. 2p.
Patent; fabrication. LEAD-ACID BATTERIES; ANODES;FABRICATION;GRIDS;SULFURIC ACID; NAPHTHALENE;HEATING;PERFORMANCE

3633 TUBULAR ELECTRODES FOR BATTERIES. Krug, H.; Niklas, H.; Thoernblad, R. (to Varta Batterie AG). German(FRG) Patent 2,347,957. 24 Apr 1975. Filed date 24 Sep 1973. 9p.
Patent; Pb or Pb--Sb alloys. LEAD-ACID BATTERIES;ELECTRODES;TUBES;LEAD;LEAD ALLOYS; ANTIMONY ALLOYS;ANODES;DESIGN

3634 ELECTRODE PACK FOR STORAGE BATTERIES. Rothbauer, H. (to Maxs AG). British Patent 2,346,976. 24 Apr 1975. Filed date 18 Sep 1973. 10p.
Patent; flexible conductor/insulating-separator/conductor assembly. NICKEL-CADMIUM BATTERIES;ELECTRODES;HYDROXIDES;FABRICATION

3635 NEGATIVE BATTERY ELECTRODES FOR REVERSIBLE STORAGE AND REGENERATION OF HYDROGEN. Schmitt, R. (to Battelle Memorial Institute, International Division). German(FRG) Patent 2,449,832. 24 Apr 1975. Filed date 18 Oct 1973. 21p.
HYDROGEN STORAGE;ELECTRIC BATTERIES;NICKEL-HYDROGEN BATTERIES;ANODES;HYDROGEN;HYDROXIDES; TITANIUM HYDRIDES;NICKEL HYDRIDES

3636 TUBULAR ELECTRODE PLATES FOR BATTERIES. Acton, R.G.; Andrew, D.R.; Hulme, H. (to Oldham International Ltd.). German(FRG) Patent 2,447,652. 24 Apr 1975. Filed date 11 Oct 1973. 16p.
Patent; methods for preparation. LEAD-ACID BATTERIES;ELECTRODES;TUBES;PLATES;FABRICATION; LEAD;LEAD OXIDES;WATER

3637 ALLOY COMPOSITION AND ITS USE IN PREPARING PARTS FOR LEAD STORAGE BATTERIES. Rao, P.; Mao, G.W. (to Gould, Inc.). German(FRG) Patent 2,441,097. 24 Apr 1975. Filed date 3 Oct 1973. 19p.
LEAD-ACID BATTERIES;LEAD ALLOYS;CADMIUM ADDITIONS;TIN ADDITIONS;ELECTRODES;CONNECTORS; MATERIALS;FABRICATION

3638 ZINC ANODIC MIXES FOR ALKALINE BATTERIES. Tsuchida, T.; Shinoda, K.; Yamamoto, K.; Takase, N. (to Fuji Electrochemical Co., Ltd.). Japanese Patent 45,925. 24 Apr 1975. Filed date 30 Aug 1973. 4p.
ZINC;ANODES;HYDROXIDES;CELLULOSE ESTERS; POWDERS;POTASSIUM HYDROXIDES;WATER;GELS; CHEMICAL PREPARATION;NICKEL-ZINC BATTERIES; SILVER-ZINC BATTERIES;ZINC-MANGANESE BATTERIES; ZINC-AIR BATTERIES;ZINC-CHLORINE BATTERIES; ELECTRIC BATTERIES

3639 IRON--ALKALINE BATTERY. Yabumoto, T.; Ohsawa, K. (to Furukawa Electric Co., Ltd.). Japanese Patent 45,243. 23 Apr 1975. Filed date 28 Aug 1973. 2p.
Patent; effects of EDTA addition to KOH electrolyte on utilization coefficient of anode-active mass. EDTA;POTASSIUM HYDROXIDES;IRON; ELECTRIC BATTERIES;IRON-NICKEL BATTERIES; ELECTROLYTES;IRON HYDROXIDES;MERCURY OXIDES; PHOSPHORIC ACID;ANODES

3640 IRON--ALKALI BATTERIES. Yabumoto, T.; Ohsawa, K. (to Furukawa Electric Co., Ltd.). Japanese Patent 45,244. 23 Apr 1975. Filed date 28 Aug 1973. 2p.
Patent; effect of tartrate addition on utilization coefficient of Fe anode-active mass. ELECTRIC BATTERIES;IRON-NICKEL BATTERIES; TARTRATES;HYDROXIDES;ELECTROLYTES;IRON;IRON HYDROXIDES;PHOSPHORIC ACID;FABRICATION; POTASSIUM HYDROXIDES;IRON IONS;OXIDATION;SODIUM COMPOUNDS;POTASSIUM COMPOUNDS;ANODES

3641 BATTERY VENT PLUG. Hennen, R.E. (to Globe-Union Inc., Milwaukee, WI). US Patent 3,879,227. 22 Apr 1975. Filed date 10 Dec 1973. 10p.
Patent; designed to extinguish flaming battery gas. VENTS;CLOSURES;DESIGN;ELECTRIC BATTERIES;LEAD-ACID BATTERIES

3642 ELECTRIC STORAGE BATTERY GRIDS. Peters, K. (to Electric Power Storage Ltd., London, England). US Patent 3,879,217. 22 Apr 1975. Filed date 13 Feb 1974. 4p.
Patent; alloy with improved casting properties. LEAD-ACID BATTERIES;GRIDS;LEAD BASE ALLOYS;ANTIMONY ALLOYS;SELENIUM ADDITIONS; ARSENIC ADDITIONS;COPPER ADDITIONS;TIN ADDITIONS;CASTING

3643 CADMIUM PASTE ELECTRODES FOR ALKALINE CELLS. Yoshida, S. (to Yuasa Battery Co., Ltd.). Japanese Patent 44,431. 21 Apr 1975. Filed date 23 Aug 1973. 3p.
HYDROXIDES;CADMIUM;FABRICATION;COATINGS; CADMIUM OXIDES;ELECTRODES;ELECTRIC BATTERIES; ANODES;SILVER-CADMIUM BATTERIES;NICKEL-CADMIUM BATTERIES

3644 CATHODES FOR MULTILAYER BATTERIES. Takeuchi, K.; Hayashi, Y. (to Yuasa Battery Co., Ltd.). Japanese Patent 43,432. 19 Apr 1975. Filed date 21 Aug 1973. 3p.
Patent; fabrication, $MnO_2$ + C with teflon binder. LAYERS;CATHODES;ELECTRIC BATTERIES; MANGANESE OXIDES;CARBON;POWDERS;FABRICATION; TEFLON

3645 PASTE TYPE CADMIUM ANODES FOR ALKALINE BATTERIES. Yoshida, S. (to Yuasa Battery Co., Ltd.). Japanese Patent 42,346. 17 Apr 1975. Filed date 17 Aug 1973. 2p.
Patent; CdS base, mixed with $H_2O$, $H_2O$-miscible organic solvent, and binder. CADMIUM; ANODES;HYDROXIDES;NICKEL-CADMIUM BATTERIES; SILVER-CADMIUM BATTERIES;ELECTRIC BATTERIES; CADMIUM SULFIDES;NICKEL;WATER;PVA;GLYCEROL; FABRICATION;AQUEOUS SOLUTIONS;BINDERS

3646 LEAD ALLOY AND BATTERY GRID PREPARED FROM IT. Mao, G.W.; Rao, P. (to Gould, Inc.). German(FRG) Patent 2,441,098. 17 Apr 1975. Filed date 3 Oct 1973. 16p.
Patent; 0.06 to 0.1 Ca and 0.1 to 0.4 percent Sn. LEAD-ACID BATTERIES;GRIDS;LEAD BASE ALLOYS;CALCIUM ADDITIONS;TIN ADDITIONS;CASTING

3647 CELL HAVING ANODE CONTAINING SILVER ADDITIVE FOR ENHANCED OXYGEN RECOMBINATION. Rampel, G.G. (to General Electric Co.). US Patent 3,877,985. 15 Apr 1975. Filed date 18 Apr 1971. 6p.
NICKEL-CADMIUM BATTERIES;ANODES;SILVER ADDITIONS;OXYGEN;RECOMBINATION;CHEMICAL REACTIONS;FABRICATION;GASES

3648 CATALYTIC PASTE AND ELECTRODE. Chottiner, J. (to Westinghouse Electric Corp.). US Patent 3,877,994. 15 Apr 1975. Filed date 25 Oct 1972. 6p.
Patent; C, binder, catalyst, $H_2O$, thickener. ELECTRODES;ELECTRIC BATTERIES;CARBON;BINDERS; CATALYSTS;WATER;ETHERS;FABRICATION;TEFLON; SILVER NITRATES;PERFORMANCE

3649 RECHARGEABLE CELL HAVING IMPROVED CADMIUM NEGATIVE ELECTRODE AND METHOD OF PRODUCING SAME. Catherino, H.A. (to General Electric Co., Owensboro, KY). US Patent 3,877,986. 15 Apr 1975. Filed date 25 Jul 1972. 8p.
ANODES;NICKEL-CADMIUM BATTERIES;SILVER-CADMIUM BATTERIES;CADMIUM;CADMIUM OXIDES; POWDERS;QUANTITY RATIO;PERFORMANCE;FABRICATION; ELECTRIC BATTERIES

3650 APPARATUS AND METHOD FOR CHARGING A ZINC ELECTRODE. Saridakis, N. (to Volkswagenwerk AG). German(FRG) Patent 2,342,579. 10 Apr 1975. Filed date 23 Aug 1973. 9p.
Patent; bubbling of air to prevent dendrite formation and slope change. NICKEL-ZINC BATTERIES;SILVER-ZINC BATTERIES;ANODES;ELECTRIC BATTERIES;BATTERY CHARGING;AIR;BUBBLES;DESIGN

3651 ELECTRODE FOR ALKALINE BATTERIES. Iwaki, T.; Mitsumata, T. (to Matsushita Electric Industrial Co., Ltd.). Japanese Patent 36,936. 7 Apr 1975. Filed date 9 Aug 1973. 3p.

Patent; fabrication using loaded Ni sponge. ELECTRODES;HYDROXIDES;FABRICATION;NICKEL;NICKEL NITRATES;CATHODES;NICKEL-CADMIUM BATTERIES; PERFORMANCE;ELECTRIC BATTERIES

3652 LEAD STORAGE BATTERY. Asai, K. (to Agency of Industrial Sciences and Technology). Japanese Patent 36,928. 7 Apr 1975. Filed date 8 Aug 1973. 3p.
Patent; improved results with controlled electrolyte density. LEAD-ACID BATTERIES; ELECTROLYTES;DENSITY;SULFURIC ACID

3653 OXYGEN ELECTRODE FOR ALKALINE BATTERY. Henssen, H.F. (to Deutsche Carbone AG). German(FRG) Patent 2,345,473. 3 Apr 1975. Filed date 8 Sep 1973. 11p.
CATHODES;ACTIVATED CARBON;SILVER;COATINGS; METAL-GAS BATTERIES;ZINC-AIR BATTERIES

3654 PASTED LEAD--ACID PLATE FOR AN ELECTRIC STORAGE BATTERY. Wheadon, E.G.; Willmann, N.L.; McCartney, C.P., Jr. (to General Motors Corp.). German(FRG) Patent 2,444,861. 3 Apr 1975. Filed date 20 Sep 1973. 19p.
Patent; structure and manufacturing method. LEAD-ACID BATTERIES;PLATES;DESIGN;FABRICATION; LEAD;LEAD ALLOYS;THICKNESS

3655 SEPARATOR FOR LEAD STORAGE BATTERY. Ito, T.; Ohtomo, K. (to Kanebo, Ltd.). German(FRG) Patent 2,442,361. 3 Apr 1975. Filed date 5 Sep 1973. 20p.
LEAD-ACID BATTERIES;BATTERY SEPARATORS; PHENOLS;RESINS;FIBERS

3656 SHEATHING THE ACTIVE MASS OF A LEAD STORAGE BATTERY. Metzler, O. German(FRG) Patent 2,346,517. 3 Apr 1975. Filed date 15 Sep 1973. 7p.
LEAD-ACID BATTERIES;TUBES;PLATES; POLYETHYLENES;TEFLON;PVC;METHACRYLIC ACID ESTERS;PRESSING;FABRICATION;SINTERING;BINDERS; GRAPHITE;SULFONIC ACIDS

3657 METHOD OF PREPARING ELECTRODES WITH POROUS CURRENT COLLECTOR STRUCTURES AND SOLID REACTANTS FOR SECONDARY ELECTROCHEMICAL CELLS. Gay, E.C.; Martino, J. (to ERDA). US Patent 3,933,520. 3 Apr 1975. vp.
A method of preparing an electrode for use in a high-temperature, secondary, electrochemical cell is described which comprises distributing solid, particulate, electrode, reactant material over an upper surface of an electrically conductive porous substrate; vibrating the substrate to impregnate the reactant material into a portion of the void volume of the porous substrate; and filling substantially all of the remaining void volume of the substrate with molten electrolytic salt. A secondary, high-temperature, electrochemical cell including an alkali metal alloy reactant in the negative electrode, a metal sulfide reactant in the positive electrode, and a molten electrolyte containing ions of this alkali metal is improved in that at least one of the electrodes comprises an integral, porous substrate of electrically conductive material impregnable by molten electrolyte and having solid particles of reactant distributed throughout the void volume of said substrate.

3658 BATTERY SEPARATORS. Haefner, A.J.; Glass, J.B.; Burt, W.E. (to Ethyl Corp.). US Patent 3,875,270. 1 Apr 1975. Filed date 10 Sep 1969. 6p.
Patent; $BaSO_4$ or diatomaceous earth. BATTERY SEPARATORS;BARIUM SULFATES;DIATOMACEOUS EARTH; PVC;SINTERED MATERIALS;RESINS;FABRICATION

3659 ENERGETICS OF THE ORGANIC ELECTRODES OF ACCUMULATORS. Kergreis, A.; Auclair, B.; Guillou, M. (Univ. de Paris, France). Rev. Gen. Electr.; 84: No. 4, 255-62(Apr 1975).
FUEL CELLS;ELECTRIC BATTERIES;ELECTRODES; ELECTROLYTES;MATERIALS

3660 SEALED ALKALINE BATTERIES. Tada, T. (to Sanyo Electric Co., Ltd.). Japanese Patent 33,430. 31 Mar 1975. Filed date 30 Jul 1973. 3p.
Patent; addition of LiOH and NaOH to KOH. ELECTRIC BATTERIES;ELECTROLYTES;SEALS;POTASSIUM HYDROXIDES;LITHIUM HYDROXIDES;SODIUM HYDROXIDES; PERFORMANCE TESTING;MEDIUM TEMPERATURE

3661 GEL-LIKE ZINC ANODE MIX FOR ALKALINE CELLS. Tsuchida, T.; Shinoda, K.; Yamamoto, K.; Itagaki, Y. (to Fuji Electric Co., Ltd.). Japanese Patent 31,327. 27 Mar 1975. Filed date 23 Jul 1973. 3p.
ELECTRIC BATTERIES;ANODES;ZINC;GELS; HYDROXIDES;ZINC OXIDES;GASES;LEAKS;POTASSIUM HYDROXIDES;CHEMICAL PREPARATION;CELLULOSE;ZINC-MANGANESE BATTERIES;SILVER-ZINC BATTERIES; NICKEL-ZINC BATTERIES

3662 COLLOIDAL ELECTROLYTE LEAD STORAGE BATTERIES. Terae, K. (to Atsumi Mfg. Co., Ltd.). Japanese Patent 31,332. 27 Mar 1975. Filed date 25 Jul 1973. 2p.
LEAD-ACID BATTERIES;ELECTROLYTES;COLLOIDS; CHEMICAL PREPARATION;SULFURIC ACID;SILICIC ACID; SODIUM SILICATES;FABRICATION;SOLIDS

3663 NICKEL ELECTRODES FOR ALKALINE CELLS. Yamaguchi, S.; Inada, K.; Shiojima, N.; Saiki, N.; Ishido, O. (to Ray-O-Vac Co. (Japan), Ltd.). Japanese Patent 31,336. 27 Mar 1975. Filed date 23 Jul 1973. 4p.
NICKEL;HYDROXIDES;CHEMICAL PREPARATION; SINTERED MATERIALS;NICKEL NITRATES;CADMIUM NITRATES;ELECTRODES;ELECTRIC BATTERIES;NICKEL-CADMIUM BATTERIES;NICKEL-ZINC BATTERIES;IRON-NICKEL BATTERIES;CATHODES

3664 POLYPROPYLENE SEPARATORS FOR BATTERIES. Iwaki, T.; Kobayashi, Y. (to Matsushita Electric Industrial Co., Ltd.). Japanese Patent 30,025. 26 Mar 1975. Filed date 20 Jul 1973. 3p.
BATTERY SEPARATORS;POLYPROPYLENE;CHEMICAL PREPARATION;FABRICATION;FILMS;NICKEL-CADMIUM BATTERIES;PERFORMANCE

3665 AMALGAMATION OF ZINC POWDERS. Takenaka, T. (to Hitashi Makuseru Co., Ltd.). Japanese Patent 30,024. 26 Mar 1975. Filed date 20 Jul 1973. 2p.
NICKEL-ZINC BATTERIES;SILVER-ZINC BATTERIES; ZINC-AIR BATTERIES;ZINC-MANGANESE BATTERIES; ANODES;ZINC;ELECTRIC BATTERIES;POTASSIUM HYDROXIDES;MERCURY;HYDROXIDES;CHEMICAL PREPARATION

3666 CADMIUM ELECTRODES. Pickett, D.F. (to United States Dept. of the Air Force). US Patent 3,873,368. 25 Mar 1975. Filed date 29 Jun 1973. 7p.
Preparation;patent. NICKEL-CADMIUM BATTERIES; SILVER-CADMIUM BATTERIES;ANODES;FABRICATION;

CHEMICAL PREPARATION

3667 ZINC-CONTAINER ELECTRODE. Kandler, L. (to Rheinisccch-Westfalisches Elektrizitatswerk AG). US Patent 3,873,367. 25 Mar 1975. Filed date 17 Aug 1970. 6p.
Patent; design and performance. ZINC; ELECTRODES;HYDROXIDES;ELECTRIC BATTERIES;ZINC OXIDES;CALCIUM HYDROXIDES;NYLON;SHAPE; PERFORMANCE;SILVER-ZINC BATTERIES;NICKEL-ZINC BATTERIES;ANODES;ZINC-MANGANESE BATTERIES; CATHODES

3668 ZINC-CONTAINER ELECTRODE. Kandler, L. (to Rheinisch-Westfalisches-Elektrizitatswerk Aktiengesellschaft, Essen, Germany). US Patent 3,873,367. 25 Mar 1975. Filed date 12 Mar 1973. 6p.
Patent; support with chemically active mass on each side. SILVER-ZINC BATTERIES;NICKEL-ZINC BATTERIES;ANODES;HYDROXIDES;DESIGN;ZINC;ZINC COMPOUNDS;CALCIUM HYDROXIDES;ELECTRIC BATTERIES

3669 ELECTRODE FOR ELECTRICAL LEAD ACCUMULATORS. Sundberg, E.G. (to Aktiebolaget Tudor, Stockholm, Sweden). US Patent 3,873,366. 25 Mar 1975. Filed date 11 Jul 1973. 6p.
LEAD-ACID BATTERIES;ELECTRODES;GRIDS;DESIGN; FABRICATION

3670 CADMIUM ANODES FOR ALKALINE BATTERIES. Mukunoki, J.; Yasuda, K.; Wakatsuki, K. (to Matsushita Electric Industrial Co., Ltd.). Japanese Patent 28,644. 24 Mar 1975. Filed date 17 Jul 1973. 2p.
Patent; fabrication method for improved mechanical strength. NICKEL-CADMIUM BATTERIES; SILVER-CADMIUM BATTERIES;CADMIUM;ANODES; HYDROXIDES;ELECTRIC BATTERIES;FABRICATION; ORGANIC COMPOUNDS;AQUEOUS SOLUTIONS;BINDERS; CADMIUM OXIDES;PVA;GLYCOLS

3671 CADMIUM ANODES FOR ALKALINE CELLS. Mukunoki, J.; Yasuda, K.; Wakatsuki, K. (to Matsushita Electric Industrial Co., Ltd.). Japanese Patent 28,643. 24 Mar 1975. Filed date 17 Jul 1973. 2p.
NICKEL-CADMIUM BATTERIES;SILVER-CADMIUM BATTERIES;CADMIUM;ANODES;ELECTRIC BATTERIES; HYDROXIDES;CADMIUM OXIDES;ORGANIC POLYMERS; FLUORINATED ALIPHATIC HYDROCARBONS;CARBON BLACK; PVA;GLYCOLS

3672 ALKALINE ELECTROLYTE SOLUTIONS CONTAINING INDIUM AND VANADIUM FOR AIR--ZINC TYPE SECONDARY BATTERIES. Ikeda, H.; Furukawa, N.; Inoguchi, H. (to Agency of Industrial Sciences and Technology). Japanese Patent 28,640. 24 Mar 1975. Filed date 18 Jul 1973. 3p.
Patent; prevention of dendrite growth. ZINC-AIR BATTERIES;ELECTROLYTES;SOLUTIONS;INDIUM COMPOUNDS;VANADIUM COMPOUNDS;HYDROXIDES; VANADIUM OXIDES;INDIUM HYDROXIDES;SODIUM HYDROXIDES;ZINC;DENDRITES

3673 SEALED SILVER OXIDE STORAGE BATTERY. Ohhira, T.; Ikeda, Y.; Yokoyama, T.; Sekida, S. (to Matsushita Electric Industrial Co., Ltd.). Japanese Patent 28,642. 24 Mar 1975. Filed date 20 Jul 1973. 3p.
Patent; Ag/Zn yielded 400 mAh/g. FABRICATION; SILVER OXIDES;CADMIUM OXIDES;LEAD;LEAD COMPOUNDS;CATHODES;SILVER-ZINC BATTERIES; POTASSIUM HYDROXIDES;LEAD COMPOUNDS;OXYGEN; GASES;SILVER-CADMIUM BATTERIES

3674 LEAD--CALCIUM ALLOY GRIDS FOR LEAD STORAGE BATTERY ELECTRODES. Nagata, Y. (to Furukawa Electric Co., Ltd.). Japanese Patent 28,638. 24 Mar 1975. Filed date 20 Jul 1973. 3p.
LEAD-ACID BATTERIES;ELECTRODES;GRIDS; SINTERED MATERIALS;LEAD BASE ALLOYS;CALCIUM ADDITIONS;BINDERS

3675 ZINC ANODES FOR SECONDARY BATTERIES. Ohsawa, K.; Yabumoto, T. (to Furukawa Electric Co., Ltd.). Japanese Patent 27,928. 22 Mar 1975. Filed date 13 Jul 1973. 3p.
Patent; fabrication, polyethyleneimine to prevent electrodeposition of Zn on anode. NICKEL-ZINC BATTERIES;SILVER-ZINC BATTERIES; ZINC-MANGANESE BATTERIES;ZINC;ANODES;ELECTRIC BATTERIES;ZINC OXIDES;POWDERS;POTASSIUM HYDROXIDES;IMINES;FABRICATION

3676 NEGATIVE ELECTRODE FOR ELECTROCHEMICAL GENERATOR. Viescou, C. (to Compagnie Industrielle Des Piles Electriques ''Cipel''). US Patent 3,871,918. 18 Mar 1975. Priority date 30 May 1972, France. 6p.
An electrochemical storage cell embodying a novel negative electrode of zinc powder grains suspended in a three-dimensional gel constituted by a polymerizing reaction product of acrylamide, acrylic acid, and methylenebisacrylamide; a novel polymer-type electrolyte for this cell; a method of preparing the negative electrode and electrolyte; and a method for producing the cell are described. 3 figures. (auth)

3677 BATTERY PLATE FORMING APPARATUS. Barrett, J.H. Jr. US Patent 3,871,919. 18 Mar 1975. Filed date 24 Sep 1969. 6p.
A battery-plate-forming tank having a removable cover with a filter vent therein to permit the gases generated in the forming process to escape but to condense and retain acid vapors in the tank is described. An adjustable rack is located in the tank for supporting spaced parallel battery plates with their shorter sides vertical and their longer sides horizontal for easy viewing and access. 7 figures. (auth)

3678 ANODES FOR ALKALINE BATTERIES. Tsuchida, T.; Shinoda, K.; Yamamoto, K.; Murata, T. (to Fuji Electrochemical Co., Ltd.). Japanese Patent 24,733. 17 Mar 1975. Filed date 4 Jul 1973. 4p.
Patent; gel-like anode for alk. batteries using air, O, $Ag_2O$, HgO, or $MnO_2$ cathodes and Fe or Zn anodes. ANODES;POTASSIUM HYDROXIDES; SILVER-ZINC BATTERIES;ZINC-MANGANESE BATTERIES; ZINC-AIR BATTERIES;CELLULOSE;ZINC ALLOYS; MERCURY ALLOYS;POLYACRYLATES;SODIUM COMPOUNDS; PERFORMANCE;LEAKS;ELECTRIC BATTERIES

3679 ZINC POWDER FOR BATTERIES. Nicaise, R. (to Metallurgie Hokoken-Overpelt). Belgian Patent 819,926. 17 Mar 1975. Filed date 19 Sep 1973. 4p.
ZINC;POWDERS;FABRICATION;ZINC ALLOYS;MERCURY ALLOYS;ELECTRIC BATTERIES;ELECTRODES;ZINC-MANGANESE BATTERIES;SILVER-ZINC BATTERIES; NICKEL-ZINC BATTERIES;ANODES

3680 NICKEL HYDROXIDE ELECTRODE. Ness, P.; Kraemer, G.; Tisch, E. (to Varta Batterie A.-G.). GE 2,340,869. 13 Mar 1975. Filed date 13 Aug 1973. 9p.

Chemical preparation;patent. NICKEL HYDROXIDES;CADMIUM HYDROXIDES;COBALT HYDROXIDES; CHEMICAL PREPARATION;IRON-NICKEL BATTERIES; NICKEL-CADMIUM BATTERIES;NICKEL-ZINC BATTERIES; ELECTRIC BATTERIES;CATHODES

3681 LEAD DIOXIDE--TITANIUM COMPOSITE ANODES. Habermann, W.; Nohe, H.; Jaeger, P. GE 2,344,645. 13 Mar 1975. Filed date 05 Sep 1973. 6p.
LEAD-ACID BATTERIES;COMPOSITE MATERIALS;LEAD OXIDES;TITANIUM;ANODES;PERFORMANCE;FABRICATION

3682 BIPOLAR ELECTRODE FOR SECONDARY BATTERY OF HIGH ENERGY DENSITY. Symons, P.C.; Bjorkman, H.K. (to Energy Development Associates). German(FRG) Patent 2,441,704. 13 Mar 1975. Filed date 31 Aug 1973. 46p.
METAL-NONMETAL BATTERIES;ELECTRODES;ZINC; GRAPHITE;CARBON;HALIDES;ZINC CHLORIDES

3683 SINTERED ELECTRODES FOR BATTERIES. Saeufferer, H. (to Daimler-Benz AG). German(FRG) Patent 2,339,870. 13 Mar 1975. Filed date 7 Aug 1973. 6p.
SINTERED MATERIALS;ELECTRODES;FABRICATION; ELECTRIC BATTERIES;ULTRASONIC WAVES

3684 CATHODE FOR THE REDUCTION OF OXYGEN AND A RECHARGEABLE CELL COMPRISING SAID CATHODE. Bonnemay, M.; Bronoel, G.R.; Donnet, J.P.; Lahaye, J.; Sarrandin, J.A. US Patent 3,870,565. 11 Mar 1975. Priority date 19 Jun 1973, France. 8p.
CATHODES;REDUCTION;OXYGEN;CATALYSTS;CARBON; FUEL CELLS;ZINC-AIR BATTERIES;DESIGN

3685 BATTERY SEPARATOR MANUFACTURING PROCESS. Palmer, N.I.; Sugarman, N. (to W.R. Grace and Co., Cambridge, MA). US Patent 3,870,567. 11 Mar 1975. Filed date 21 Dec 1972. 16p.
Patent; improved retention of wetting agent. BATTERY SEPARATORS;FABRICATION;FIBERS; THERMOPLASTICS;WETTING AGENTS;HEATING; COMPRESSION;POLYPROPYLENE;AUTOMOBILES; SURFACTANTS;LEAD-ACID BATTERIES

3686 USE OF NICKEL HYDROXIDE IN PRESSED PLATE ELECTRODES. Catherino, H.A. (to General Electric Co.). US Patent 3,870,562. 11 Mar 1975. Filed date 17 Jun 1974. 8p.
The addition of 0.1 to 5 percent $Ni(OH)_2$ to the anode material of an alkaline battery helps maintain the rechargeability of the anode for many cycles. Typical anode material consists of up to $^1/_3$ Cd particles 5 to 10 μm in diameter, with the remainder almost entirely CdO. About 1 percent $Ni(OH)_2$ and 1 percent Teflon are added. Charge retention capacity is improved about 25 percent with the addition of nickel hydroxide. (RWR)

3687 IRON ELECTRODES FOR ALKALINE BATTERIES. Fukuda, M.; Mitsumata, T.; Iwaki, T. (to Agency of Industrial Sciences and Technology). Japanese Patent 21,231. 9 Mar 1975. Filed date 29 Jun 1973. 4p.
Fe/KOH/air; patent. METAL-GAS BATTERIES;IRON; POTASSIUM HYDROXIDES;AIR;POWDERS;SINTERING; FABRICATION;POTASSIUM SULFIDES;ELECTRODES

3688 SEPARATOR FOR ELECTRIC STORAGE BATTERY. Zenczak, P. (to Evans Products Co.). German(FRG) Patent 1,596,064. 6 Mar 1975. Filed date 13 Dec 1965. 5p.
Patent; coated phenol--aldehyde resin-impregnated cellulose paper. BATTERY SEPARATORS; CHEMICAL PREPARATION;PAPER;CELLULOSE;TALC;PVC

3689 ELECTRODE FOR A ZINC--HALOGEN BATTERY. (to Unigate Ltd.). German(FRG) Patent 2,440,630. 6 Mar 1975. Filed date 24 Aug 1973. 13p.
Patent; fabrication. METAL-GAS BATTERIES; ZINC-CHLORINE BATTERIES;ELECTRODES;FABRICATION; NEOPRENE;WATER;ACETONE;HIGH TEMPERATURE

3690 GAS DIFFUSION OF ELECTRODES FOR AIR CELLS. Fukuda, M.; Iwaki, T.; Kobayashi, Y. (to Agency of Industrial Sciences and Technology). Japanese Patent 21,225. 6 Mar 1975. Filed date 29 Jun 1973. 3p.
METAL-GAS BATTERIES;CATHODES;ZINC-AIR BATTERIES;CATALYSTS;NICKEL COMPOUNDS;CARBONYLS; CARBON;SINTERING;TEFLON;HEAT TREATMENTS; FABRICATION;COBALT COMPLEXES;PHTHALOCYANINES

3691 GAS DIFFUSION ELECTRODES FOR BATTERIES. Fukuda, M.; Iwaki, T.; Matsumoto, I. (to Agency of Industrial Sciences and Technology). Japanese Patent 21,237. 6 Mar 1975. Filed date 29 Jun 1973. 4p.
Patent; slurry of active C, resin, and solvent on support. METAL-GAS BATTERIES;FUEL CELLS;ELECTRODES;IRON;AIR;FABRICATION;SLURRIES; FLUORINATED ALIPHATIC HYDROCARBONS;COPOLYMERS; ETHYL ETHER;PALLADIUM;CATALYSTS;CARBON

3692 SEPARATORS FOR STORAGE BATTERIES. Hirano, M.; Tanso, S.; Murata, K. (to Yuasa Battery Co., Ltd.). Japanese Patent 21,229. 6 Mar 1975. Filed date 30 Jun 1973. 3p.
Patent; discontinuous ribs of thermoplastic resins on flexible sheets of synthetic resin. BATTERY SEPARATORS;FABRICATION;RESINS; THERMOPLASTICS;POLYETHYLENES;PERFORMANCE

3693 BONDED METAL ELECTRODES. Alder, H.P. (to du Pont de Nemours, E.I., and Co.). British Patent 1,386,497. 5 Mar 1975. Filed date 31 Jul 1972. 5p.
Patent; improved contact achieved by cold pressing etched collector sheet. LITHIUM-SULFUR BATTERIES;ANODES;LITHIUM;CONNECTORS;BONDING; COLD PRESSING;STAINLESS STEELS;ETCHING;COPPER; SULFUR;LITHIUM COMPOUNDS;CHLORATES;ELECTRIC BATTERIES;ELECTRODES;FURANS;ETHERS

3694 SINTERED NICKEL ELECTRODES FOR ALKALINE STORAGE BATTERIES. Ohnuma, S.; Ishido, O. (to Ray-O-Vac Co., Ltd., Japan). Japanese Patent 21,233. 5 Mar 1975. Filed date 28 Jun 1973. 3p.
IRON-NICKEL BATTERIES;NICKEL-CADMIUM BATTERIES;NICKEL-ZINC BATTERIES;NICKEL;ELECTRIC BATTERIES;CATHODES;SINTERED MATERIALS; HYDROXIDES;CHEMICAL PREPARATION;NICKEL HYDROXIDES;NICKEL NITRATES;BINDERS;FABRICATION; POTASSIUM HYDROXIDES;PERFORMANCE

3695 BETA-ALUMINA ELECTROLYTE. Markin, T.L.; Bones, R.J.; Woodhead, J.L.; Wassell, L.L. (to United Kingdom Atomic Energy Authority). British Patent 1,386,244. 5 Mar 1975. Filed date 26 Jul 1971. 6p.
Preparation of a homogeneous β-alumina tube electrolyte for a sodium--sulfur battery is discussed. Wall thickness was 300 μm. The tube electrolyte was made by plasma spraying 15-μm β-alumina spheres, which were prepared by calcining at 1000° spheres of a water-dispersible aluminum oxide gel doped with sodium ions. (RWR)

3696 ALLOY FOR THROUGH-THE-PARTITION INTERCELL CONNECTORS FORMED BY AN EXTRUSION-FUSION TECHNIQUE. Matter, R.C. (to General Motors Corp.). US Patent 3,869,316. 04 Mar 1975. Filed date 23 Nov 1973. 10p.
LEAD-ACID BATTERIES;CONNECTORS;FABRICATION; LEAD BASE ALLOYS;ANTIMONY ALLOYS;TIN ADDITIONS; ELECTRIC BATTERIES

3697 SOLID ELECTROLYTE. Harada, M.; Ohta, T.; Imai, A. (to Tokyo Shibaura Electric Co., Ltd.). Japanese Patent 5,384. 3 Mar 1975. Filed date 7 Dec 1970. 3p.
Patent; β-alumina, fabrication. ELECTRIC BATTERIES;SODIUM-SULFUR BATTERIES;ELECTROLYTES; SOLIDS;ALUMINIUM OXIDES;SODIUM OXIDES;DOPED MATERIALS;FABRICATION

3698 SOLID ELECTROLYTE. Harada, M.; Ohta, T.; Imai, A.; Ogawa, Y. (to Tokyo Shibaura Electric Co., Ltd.). Japanese Patent 5,383. 3 Mar 1975. Filed date 4 Dec 1970. 4p.
Patent; improved electrolyte. ALUMINIUM OXIDES;BUTANOLS;RESINS;FILMS;SINTERING;ELECTRIC CONDUCTIVITY;ELECTROLYTES;SOLIDS;SODIUM-SULFUR BATTERIES;ELECTRIC BATTERIES

3699 PAPERS OR UNWOVEN CLOTHS FOR ALKALINE CELL SEPARATORS. Murakami, S.; Mizutani, K.; Ashikaga, T. (to Kuraray Co., Ltd.). Japanese Patent 18,944. 27 Feb 1975. Filed date 23 Jun 1973. 6p.
HYDROXIDES;BATTERY SEPARATORS;PAPER;PVA; FIBERS;AQUEOUS SOLUTIONS;SODIUM HYDROXIDES; SODIUM SULFATES;FABRICATION

3700 ALKALINE ELECTROLYSE FOR GALVANIC CELLS CONTAINING HYDROGEN-STORAGE ELECTRODES. von Benda, K.; Lohnert, W. (to Deutsche Automobilgesellschaft m.b.H.). German(FRG) Patent 2,231,348/C/. 27 Feb 1975. 3p. (In German).
The $H_2$ storage capacity of negative electrodes of alkali primary-secondary hybrid batteries is stabilized according to the invention, in that, besides the alkali ions, additional ions of at least a metal not belonging to the group of alkali metals contained in the electrolyte. The dissociation potential of the required metals should be at least 50 mV more negative than the reversible $H_2$ potential in the same electrolyte. Aluminium ions are considered to be particularly suitable. Furthermore, zinc, vanadium, molybdenum, tungsten, beryllium, gallium and tin ions, however, are also used.

3701 CARBON ELECTRODE. Katase, M.; Iwaki, H.; Shibamiya, S. (to Showa Denko K.K.). Japanese Patent 18,359. 26 Feb 1975. Filed date 22 Jun 1973. 3p.
Paten; fabrication and physical properties. ELECTRIC BATTERIES;ELECTRODES;GRAPHITE;CHEMICAL PREPARATION;COKE;PHYSICAL PROPERTIES

3702 NEGATIVE IRON ACTIVE MASS ADHERING TOAN ELECTRICALLY CONDUCTING CARRIER. (to International Nickel Ltd.). Austrian Patent 320,770. 25 Feb 1975. Filed date 15 Dec 1972. 4p.
Patent; preparation. IRON-NICKEL BATTERIES; ANODES;CHEMICAL PREPARATION;IRON NITRATES; PERFORMANCE

3703 DEVICE FOR DRYING NEGATIVE PLATES AND PLATES MADE THEREWITH. Scheuerle, R.F.; Vinkler, J.F. (to ESB Inc.). US Patent 3,943,002. 25 Feb 1975. vp.
A method of drying wet formed negative storage battery plates without oxidation comprises in sequence the following steps: placing the wet formed negative plates in piled configuration in an enclosed chamber with an atmosphere therein; sealing the chamber; introducing steam into the chamber; circulating the atmosphere in the chamber and adding heat and steam at a chosen temperature profile to provide a drying cycle until the plates are dry; with circulation continuing, providing a cooling cycle by introducing an inert gas other than steam into the chamber, stopping the introduction of steam while continuing the introduction of inert gas other than steam, stopping the introduction of heat, and cooling the atmosphere in the oven until the temperature of the plates is taken below a chosen value.

3704 NICKEL ELECTRODES FOR ALKALINE BATTERIES. Kaneta, Y. (to Ray-O-Vac Co., Ltd., Japan). Japanese Patent 16,840. 21 Feb 1975. Filed date 21 Jun 1973. 4p.
NICKEL-CADMIUM BATTERIES;IRON-NICKEL BATTERIES;NICKEL-ZINC BATTERIES;CATHODES; ELECTRIC BATTERIES;NICKEL;NICKEL OXIDES;NICKEL HYDROXIDES;FABRICATION;POTASSIUM HYDROXIDES; GRAPHITE;POLYSTYRENE;RESINS;HYPOCHLOROUS ACID; ALKALI METAL COMPOUNDS;PERSULFATES

3705 NICKEL CATHODE FOR ALKALINE BATTERIES. Kanata, Y. (to Ray-O-Vac Co., Ltd., Japan). Japanese Patent 16,841. 21 Feb 1975. Filed date 21 Jun 1973. 3p.
NICKEL-CADMIUM BATTERIES;NICKEL-ZINC BATTERIES;IRON-NICKEL BATTERIES;CATHODES;NICKEL; ELECTRIC BATTERIES;NICKEL OXIDES;NICKEL HYDROXIDES;FABRICATION;HYPOCHLOROUS ACID; PERMANGANATES;ALKALI METAL COMPOUNDS;CHEMICAL PREPARATION;GRAPHITE;POLYSTYRENE;BINDERS

3706 LIQUID ELECTROLYTE FOR STORAGE BATTERIES. Befferat, A. French Patent 2,239,021. 21 Feb 1975. Filed date 23 Jul 1973. 3p.
Patent; equal amounts of $NH_3$, $H_2SO_4$, and $H_2O$; performance. LEAD-ACID BATTERIES;ELECTROLYTES; AMMONIA;SULFURIC ACID;WATER;AQUEOUS SOLUTIONS; LIQUIDS;PERFORMANCE

3707 STORAGE BATTERY WITH ZINC ELECTRODES CONTAINING TITANIUM DIOXIDE. (to ESB Inc.). French Patent 2,239,018. 21 Feb 1975. Filed date 27 Jul 1973. 12p.
Patent; anode preparation. ELECTRIC BATTERIES;SILVER-ZINC BATTERIES;NICKEL-ZINC BATTERIES;ANODES;ZINC;TITANIUM OXIDES; HYDROXIDES;ZINC ALLOYS;MERCURY ALLOYS; FABRICATION;CHEMICAL PREPARATION

3708 NICKEL CATHODES FOR ALKALINE CELLS. Kanata, Y.; Naito, M.; Ohyama, K. (to Ray-O-Vac Co., (Japan), Ltd.). Japanese Patent 16,837. 21 Feb 1975. Filed date 21 Jun 1973. 4p.
Patent; fabrication. CATHODES;NICKEL;NICKEL-CADMIUM BATTERIES;NICKEL-ZINC BATTERIES;IRON-NICKEL BATTERIES;ELECTRIC BATTERIES;NICKEL-HYDROGEN BATTERIES;FABRICATION;NICKEL HYDROXIDES;NICKEL OXIDES;HYDROXIDES;ELECTRIC POTENTIAL;STORAGE;STABILITY;GRAPHITE; POLYSTYRENE;BINDERS;POTASSIUM HYDROXIDES; PERFORMANCE

3709 ZINC ANODES FOR SECONDARY BATTERIES. Hammond, O.H. III. (to Ionics, Inc.). German(FRG) Patent 2,435,689. 20 Feb 1975. Filed date 30 Jul 1973. 23p.
Patent; 13.4 W-hr/kg, 1.54 V, 500 cycles, controlled dendritic growth. ANODES;NICKEL-ZINC BATTERIES;ZINC ALLOYS;CELLOPHANE;POTASSIUM HYDROXIDES;TEFLON;DENDRITES

3710 ALUMINIUM ANODE FOR BIOGALVANIC METAL--OXYGEN -CELLS. Weidlich, E. (to Siemens AG). German(FRG) Patent 2,336,119/A/. 20 Feb 1975. 7p. (In German).
1 fig..
The invention deals with an aluminium anode for biogalvanic metal--oxygen cells. The object of the invention is to improve further an aluminium anode for biogalvanic metal--oxygen cells. In particular, the lifetime is to be increased and the Faraday degree of efficiency is to be improved by suppressing an excessive hydrogen development. The anode is thus constructed so as to have a metal net on both sides with aluminium layers, and the surfaces of the aluminium layers not facing the metal net are lapped or sand-blasted and have an anodized layer on their boundary regions.

3711 APPARATUS AND METHOD FOR MAKING OXIDIZED EXPANDED LEAD BATTERY GRIDS. Daniels, E. Jr. (to General Motors Corp.). US Patent 3,867,200. 18 Feb 1975. Filed date 20 Sep 1973. 14p.
LEAD-ACID BATTERIES;GRIDS;FABRICATION; OXIDATION

3712 GAS-DIFFUSION ELECTRODE FOR BATTERIES. Yoko, F. Japanese Patent 75 15,043. 17 Feb 1975. Filed date 13 Jun 1973. 3p.
Patent; fabrication procedure. METAL-GAS BATTERIES;AIR;FUEL CELLS;ELECTRODES;FABRICATION; TEFLON;ACTIVATED CARBON

3713 ELECTRODE PLATE FOR ALKALINE BATTERIES. Inada, K.; Yamaguchi, S.; Shiojima, N.; Saiki, N.; Ishido, O. (to Ray-O-Vac Co., (Japan) Ltd.). Japanese Patent 75 15,042. 17 Feb 1975. Filed date 15 Jun 1973. 2p.
Patent; fabrication method. ELECTRODES; HYDROXIDES;PLATES;ELECTRIC BATTERIES; FABRICATION;NICKEL-CADMIUM BATTERIES;NICKEL-ZINC BATTERIES;IRON-NICKEL BATTERIES;SILVER-CADMIUM BATTERIES

3714 GAS-DIFFUSION ELECTRODE FOR BATTERIES. Fujita, Y. (to Agency of Industrial Sciences and Tech.). Japanese Patent 1975-15,043. 17 Feb 1975. Filed date 13 Jun 1973. 3p.
A method is described for fabricating gas--diffusion electrodes for batteries by laminating a catalyst layer containing a mixture of a powder catalyst such as silver and poly(tetrafluoroethylene), a metal grid, and a porous sheet. The pressing is carried out by placing the porous sheet on an elastic (rubber) surface to give an uneven surface with impressions of the metal grid. These electrodes are useful in fuel cells and metal--air cells.

3715 ELECTROLYTE FOR ZINC--ANODE BATTERIES. Antropov, L.I.; Pogrebova, I.S.; Dremova, G.I. (to Kiev Polytechnic Inst.). USSR Patent 460,589. 15 Feb 1975. Filed date 31 Jul 1972.
Patent; $H_2SO_4$ with N-decylpyridinium chloride. SILVER-ZINC BATTERIES;NICKEL-ZINC BATTERIES;ZINC-MANGANESE BATTERIES;ELECTROLYTES; STORAGE;SULFURIC ACID;POTASSIUM IODIDES; PYRIDINIUM COMPOUNDS;CHLORIDES

3716 BIOGALVANIC METAL--OXYGEN BATTERY. Weidlich, E. (to Siemens A.-G.). German(FRG) Patent 2,336,114. 13 Feb 1975. Filed date 16 Jul 1973. 10p.
Poly (vinyl alc.) membranes on anode; patent. METAL-GAS BATTERIES;OXYGEN;ANODES;PVA; MEMBRANES

3717 ANODE FOR A SECONDARY, HIGH-TEMPERATURE ELECTROCHEMICAL CELL. Vissers, D.R.; Tani, B.S. (to ERDA). US Patent 3,933,521. 13 Feb 1975. vp.
A secondary electrochemical cell comprising an anode containing lithium metal, a cathode containing a chalcogen material, and an electrolytic salt between the anode and cathode is improved in that the anode comprises a porous base structure with open interstitial crevices, cobalt coating on surfaces of the interstitial crevices, and the lithium metal impregnated into the interstitial crevices in contact with the cobalt coating. The anode is prepared by cleaning a mass of metallic wool comprising entangled metallic fibers, depositing a cobalt metal coating onto the metallic fibers, compacting the metallic wool to form a porous substrate, and sorbing molten lithium metal on the porous substrate.

3718 CATHODE FOR A CELL. Fukuda, M.; Iijima, T.; Kondo, S. (to Matsushita Electric Industrial Co., Ltd.). JA 03,847. 12 Feb 1975. Filed date 02 Jun 1969. 3p.
Light metal anode, nonaqueous Cl-containing electrolyte, metal halide cathode;patent. CATHODES;CHLORIDES;LITHIUM;SODIUM;CALCIUM; MAGNESIUM;ALUMINIUM;CHEMICAL PREPARATION;METAL-NONMETAL BATTERIES;CARBONIC ACID DERIVATIVES; LITHIUM CHLORIDES;ALUMINIUM CHLORIDES

3719 ELECTROCHEMICAL CELL HAVING HEAT PIPE MEANS FOR INCREASING ION MOBILITY IN THE ELECTROLYTE. Reimers, E. US Patent 3,865,630. 11 Feb 1975. Filed date 13 Jan 1971. 5p.
ELECTRIC BATTERIES;MOLTEN SALTS;ELECTROLYTES; HEATING;HEAT PIPES

3720 USE OF PEROVSKITES AND PEROVSKITE-RELATED COMPOUNDS AS BATTERY CATHODES. Longo, J.M.; Clavenna, L.R. (to Exxon Research and Engineering Co.). US Patent 3,939,008. 10 Feb 1975. vp.
An electrical energy storage device comprises a container, an electrolyte in the container, a metal anode, and a cathode-active material. The cathode-active material is an oxide of the general formula $ABO_3$ having perovskite structure, where A is selected from the group consisting of nontransition metals of Group IIa of the Periodic Table and B is a nonnoble transition metal selected from Groups VIIb and VIII of the Periodic Table.

3721 LEAD STORAGE BATTERY. Kawase, T.; Tanabe, Y.; Yuki, M. (to Matsushita Electric Industrial Co., Ltd.). Japanese Patent 12,537. 8 Feb 1975. Filed date 26 Apr 1973. 5p.
LEAD-ACID BATTERIES;ELECTRODES;GRIDS;LEAD BASE ALLOYS;ELECTROLYTES;BATTERY SEPARATORS; PHYSICAL PROPERTIES;AUTOMOBILES;PERFORMANCE; CATHODES;ANTIMONY ALLOYS;ARSENIC ADDITIONS; ANODES;CALCIUM ADDITIONS

3722 LEAD STORAGE BATTERY. Kawase, T.; Tanabe, Y.; Yuki, M. (to Matsushita Electric Industrial Co., Ltd.). Japanese Patent 12,539. 8 Feb 1975. Filed date 26 Apr 1973. 3p.
LEAD-ACID BATTERIES;ELECTRODES;GRIDS;LEAD BASE ALLOYS;FABRICATION;AUTOMOBILES;PERFORMANCE; CATHODES;ANTIMONY ALLOYS;ARSENIC ADDITIONS; ANODES;CALCIUM ADDITIONS

3723 LEAD--ANTIMONY ALLOY FOR BATTERY GRIDS. Friedheim, G. (to Accumulatorentabriken Wilhem Hagen A.-G.). German(FRG) Patent 2,337,708. 06 Feb 1975. Filed date 25 Jul 1973. 6p.
Sb 0.5-3.0, Cu 0.01-0.07, As 0.10-0.30, S 0.002-0.005, Sn 0.02-0.08, Te 0.05-0.1 percent; patent. LEAD-ACID BATTERIES;GRIDS;LEAD BASE ALLOYS;ANTIMONY ALLOYS;COPPER ADDITIONS;ARSENIC ADDITIONS;SULFUR ADDITIONS;TIN ADDITIONS; TELLURIUM ADDITIONS;FABRICATION;CASTING

3724 ELECTRIC STORAGE BATTERY. Ruben, S. German(FRG) Patent 2,434,193/A/. 6 Feb 1975. 17p. (In German).
6 figs..
A lead--acid battery with the electrodes carried on metal substrates has a reduced weight. A stretching of the positive electrode with the lead oxide on it leads to an increased efficiency of the cell.

3725 SELF-TESTING BATTERY DISCHARGE INDICATOR. York, R.A. (to Flight Systems, Inc.). US Patent 3,934,188. 4 Feb 1975. vp.
Apparatus for indicating the voltage level of a battery and for disabling a load connected to the battery is described. It consists of means for generating a control signal which is representative of the battery voltage when a first signal representative of the battery voltage is applied to the generating means and which is representative of an independent voltage which decreases at a fixed rate when the second signal representative of the independent voltage is applied to the generating means; means for selectively applying either the first signal or the second signal to the generating means so as to operate the apparatus in a battery testing or self-testing mode, respectively; first indicator means responsive to the control signal for continually indicating the instantaneous level of the battery voltage when the apparatus is in the battery testing mode and the instantaneous level of the independent voltage when the apparatus is operating in the self-testing mode, the first indicator means being electrically connected to the generator means; and second indicator means responsive to the control signal for indicating that the battery voltage has dropped below a first predetermined value when the apparatus is operating in the battery testing mode or that the independent voltage has dropped below a second predetermined value when the apparatus is operating in the self-testing mode.

3726 GRAIN REFINEMENT OF HYPOEUTECTIC LEAD--ANTIMONY CASTING ALLOYS BY ADDITIONS OF COPPER AND SULFUR. Huebner, U.; Mueller, I.; Ueberschaer, A. (Metallges, Frankfurt am Main). Z. Metallkd.; 66: No. 2, 74-79(Feb 1975). (In German).
The favorable effect of grain refinement on the hot tearing tendency of lead--antimony castings, such as battery grids, was investigated on the Pb--2.5 Sb alloy. Experimental data show that copper additions up to 0.1% cause grain refinement, the maximum effect being reached with 0.04%. The effect of sulfur is greater than that of copper, but the best results are obtained with Cu + S. Copper addition causes $Cu_2Sb$ formation, sulfur addition causes PbS formation, and combined Cu and S addition may result in $CuSbS_2$ or $Cu_2S$ formation. $Cu_2Sb$ as well as PbS may act as nucleants during the solidification of lead--antimony alloys. It is possible, however, that the grain refinement is the result of growth retardation.

3727 STRAIN HARDENING OF PB--SB ALLOYS. Bolotovskii, V.I.; Bolotovskii, N.I.; Gallai, Ya.S.; Gordyakova, G.N.; Dasoyan, M.A. Tsvetn. Met.; No. 2, 62-64(Feb 1975). (In Russian).
A study is made of the effect of rolling on the mechanical properties of lead--antimony alloys containing 1 to 7% Sb and up to 0.2% As. Area reductions of up to 30% can be used to increase product strength, while large area reductions of 40 to 80% reduce the degree of hardening of the product. By using strain hardening, it is possible to reduce the degree of alloying of battery alloys and save costly antimony.

3728 ELECTRODE FOR BATTERY. Leonardi, J. (to Societe des Accumulateurs Fixes et de Traction). French Patent 2,236,279. 31 Jan 1975. Filed date 21 Jun 1973. 6p.
NICKEL-CADMIUM BATTERIES;ELECTRODES;POWDER METALLURGY;GRIDS;FABRICATION

3729 SAFETY SHELL FOR RETENTION AND DETOXICATION OF CHLORINE RELEASED FROM METAL--CHLORINE BATTERIES. Laethem, A.F.; Carr, P. (to Energy Development Associates). German(FRG) Patent 2,431,518. 30 Jan 1975. Filed date 2 Jul 1973. 35p.
METAL-GAS BATTERIES;CHLORINE;ZINC-CHLORINE BATTERIES;LITHIUM-CHLORINE BATTERIES;ELECTRIC-POWERED VEHICLES;EMISSION;MOTOR VEHICLE ACCIDENTS;SAFETY;FOAMS;HYDRATES;SHELLS

3730 INDICATION OF GAS FORMATION AT BATTERY ELECTRODES. Nilsson, B.Y. (to Boliden AB). German(FRG) Patent 2,432,866. 30 Jan 1975. Filed date 13 Jul 1973. 7p.
ELECTRIC BATTERIES;ELECTRODES;GASES;BATTERY CHARGING;ELECTRIC CONDUCTIVITY;ELECTRIC POTENTIAL;CONTROL;ELECTRIC CURRENTS

3731 SUPPORT FOR ELECTRODE PLATES OF AIR BATTERIES. Siller, B. German(FRG) Patent 2,331,739. 30 Jan 1975. Filed date 22 Jun 1973. 10p.
SUPPORTS;PLATES;METAL-GAS BATTERIES;ELECTRIC BATTERIES;CATHODES;PVC;FILMS;FABRICATION

3732 APPARATUS FOR MANUFACTURING TUBULAR STORAGE BATTERY PLATES. Peters, K.; Gordon, R.; Sands, G. (to Chloride Group Ltd.). German(FRG) Patent 2,432,359. 30 Jan 1975. Filed date 6 Jul 1973. 37p.
LEAD-ACID BATTERIES;ELECTRODES;TUBES;PLATES; FABRICATION

3733 TUBULAR STORAGE BATTERY PLATES. Peters, K.; Gordon, R.; Sands, G. (to Chloride Group Ltd.). German(FRG) Patent 2,432,360. 30 Jan 1975. Filed date 6 Jul 1973. 43p.
Patent; paste composition, fabrication method. LEAD-ACID BATTERIES;PLATES;TUBES;

FABRICATION;LEAD OXIDES;POLYMERS;WATER;SULFURIC ACID;HETEROCYCLIC COMPOUNDS;ORGANIC OXYGEN COMPOUNDS

3734 HYBRID ELECTRODE FOR METAL/AIR CELLS. Groeppel, D.; Siemsen, G. (to Siemens Aktiengesellschaft). US Patent 3,944,434. 30 Jan 1975. Priority date 30 Jan 1974, German, Federal Republic of (F.R. Germany). vp.

A hybrid electrode for use in metal/air cells is described. It has a hydrophilic layer of nickel on the electrolyte side for use in oxygen precipitation, a hydrophobic layer of plastic on the gas side, and a hydrophobic layer of carbon between the two layers. The carbon layer contains an embedded metallic structure and is used for the dissolution of oxygen. The improvement comprises a metallic structure embedded in the carbon layer which is firmly connected on the electrolyte side to the nickel layer, with the metallic structure protruding at least partially on the gas side beyond the carbon layer and into the plastic layer, and a metallic structure embedded in the plastic layer, the metallic structure being firmly connected to the portion of the metallic structure embedded in tne carbon layer which protrudes into the plastic layer.

3735 METHOD FOR THE FABRICATION OF GALVANIC ELEMENTS SEALED AGAINST EXTERNAL AND/OR INTERNAL INFLUENCES BY A CUP-SHAPED CONTAINER WITH A TOP MADE OF THERMOPLASTIC MATERIALS. Oltman, J.E. (to ESB, Inc.). German(FRG) Patent 2,012,562/C/. 30 Jan 1975. 5p. (In German).

2 figs..

The invention deals with a method for the fabrication of galvanic elements with cup-shaped housings and with a cover in which are set two pole-terminals, each connected individually to one of the two electrodes. Both the housing and the cup-shaped cover are made of thermoplastic material. Subsequent to the assembly of the element components, the cover is permanently sealed by use of pressure and a relatively fast turning movement which produces spin-welding through heat friction with the cup-shaped housing.

3736 ALUMINA SOLID ELECTROLYTE FOR SECONDARY BATTERIES. Harada, M.; Imai, A.; Sakai, T.; Matake, S. (to Tokyo Shibaura Electric Co., Ltd.). Japanese Patent 75 08,810. 29 Jan 1975. Filed date 25 May 1973. 5p.

Patent; fabrication. ALUMINIUM OXIDES; ELECTROLYTES;FABRICATION;ELECTRIC BATTERIES; SODIUM-SULFUR BATTERIES;ELECTRIC CONDUCTIVITY; SODIUM CARBONATES;MAGNESIUM OXIDES

3737 GRID STRUCTURE FOR LEAD/ACID BATTERY. Margulies, R.S.; Biddick, R.E. (to TRW, Inc.). US Patent 346,613. 28 Jan 1975. Filed date 30 Mar 1973. 4p.

LEAD-ACID BATTERIES;PLATES;GRIDS;DESIGN

3738 BATTERY PLATE GRID. Smith, C.H.; Dunning, K.C. (to Canada Metal Co. Ltd.). Canadian Patent 961,917. 28 Jan 1975. Filed date 10 Aug 1972. 11p.

Patent; thinner grid structure. PLATES;GRIDS; FABRICATION;LEAD-ACID BATTERIES;THICKNESS; DESIGN

3739 SILVER OXIDE BATTERY ELECTRODE. Kukoz, F.I.; Ereiskaya, G.P.; Gaivoronskaya, N.P.; Goncharov, V.I.; Lozovskaya, T.A. (to Ordzhonikidze, S., Polytechnic Institute, Novocherskassk). UR 458,063. 25 Jan 1975. Filed date 24 Apr 1973. 127p.

Patent; preparation by electrochemical oxidation of Ag powder. SILVER-CADMIUM BATTERIES;SILVER-ZINC BATTERIES;ELECTRIC BATTERIES;SILVER OXIDES;CATHODES;ELECTRODES; CHEMICAL PREPARATION

3740 ELECTRODE SUPPORTS FOR ALKALINE BATTERIES. Inada, K.; Yamaguchi, S.; Shiojima, N.; Saiki, N.; Ishido, O. (to Ray-O-Vac Co., (Japan) Ltd.). Japanese Patent 7,045. 24 Jan 1975. Filed date 22 May 1973. 3p.

Patent; preparation by sintering. NICKEL-CADMIUM BATTERIES;ELECTRODES;FABRICATION; COATINGS;SINTERED MATERIALS;PERFORMANCE; SUPPORTS

3741 TESTING DEVICE FOR THE DISCHARGE STATE OF A BATTERY. Kalwa, D.; Baeumler, H. (to Licentia Patent-Verwaltungs-GmbH). German(FRG) Patent 2,333,123. 23 Jan 1975. Filed date 29 Jun 1973. 7p.

ELECTRIC BATTERIES;OPERATION;CONTROL;BATTERY CHARGING;JUNCTION DIODES;VOLTMETERS

3742 ZINC ELECTRODES FOR RECHARGEABLE BATTERIES. Hirakawa, T.; Hoshino, H. (to Asahi Chemical Industry Co., Ltd.). Japanese Patent 5,830. 22 Jan 1975. Filed date 21 May 1973. 3p.

Patent; preparation. ZINC-AIR BATTERIES; NICKEL-ZINC BATTERIES;SILVER-ZINC BATTERIES; ANODES;CALCIUM HYDROXIDES;ZINC OXIDES;ZINC; FABRICATION;PVA;CHEMICAL PREPARATION

3743 BATTERY SEPARATOR CONSTRUCTION. Afrance, F.C.; Rosa, A.C.; Haas, R.J. (to McDonnell Douglas Corp). US Patent 3,861,963. 21 Jan 1975. Filed date 23 Feb 1968. 12p.

Patent; K titanate paper or nylon. BATTERY SEPARATORS;FABRICATION;MEDIUM TEMPERATURE;BASES; HYDROXIDES;ELECTROLYTES;POTASSIUM COMPOUNDS; TITANATES;NYLON

3744 ALKALI METAL ION-CONDUCTIVE SOLID ELECTROLYTE. Nishimura, K.; Hasegawa, H.; Takagi, M. (to Showa Denko K.K.). Japanese Patent 1,836. 21 Jan 1975. Filed date 25 Dec 1968. 3p.

Patent; preparation. SODIUM-SULFUR BATTERIES; ELECTROLYTES;ALKALI METAL COMPOUNDS;OXIDES; ALUMINIUM OXIDES;ALUMINATES;SINTERED MATERIALS; ALUMINIUM HYDROXIDES;HYDROLYSIS;HEATING;SODIUM OXIDES;SINTERING;VERY HIGH TEMPERATURE;HIGH TEMPERATURE;CHEMICAL PREPARATION

3745 BATTERY CONSTRUCTION CAPABLE OF SAFELY VENTING INTERNAL PRESSURE. Michalko, I. (to Power Conversion, Inc., Mt. Vernon, NY). US Patent 3,861,964. 21 Jan 1975. Filed date 30 Jan 1973. 4p.

ELECTRIC BATTERIES;VENTS;CONTAINERS;PRESSURE RELEASE;LITHIUM-SULFUR BATTERIES

3746 SEPARATOR FOR SILVER--ZINC ELECTRIC BUTTON-TYPE CELL. Mote, H.T.; Hajdu, L.; Ronay, B. (to Medicharge, Ltd.; Medicor Muvek). GE 2,428,114. 16 Jan 1975. 14 Jun 1973. 10p.

SILVER-ZINC BATTERIES;BATTERY SEPARATORS; FABRICATION;CELLULOSE;LAYERS;CELLOPHANE;PAPER

3747 DRYING OF BATTERY PLATES. Brinkmann, J.; Saul, W. (to Varta Batterie AG).

Belgian Patent 820,204. 16 Jan 1975. Filed date 24 Sep 1973. 34p.
Patent; inducting heating. LEAD-ACID BATTERIES;LEAD;PLATES;ANODES;DRYING;MAGNETIC FIELDS;HZ RANGE;KHZ RANGE 01-100;ALTERNATING CURRENT

3748 DRY-CHARGED ZINC ELECTRODE FOR PASTED TYPE SILVER--ZINC CELLS AND STORAGE BATTERIES. Dmitrenko, V.E.; Koval, I.I.; Nikitina, Z.Y.; Markova, M.F. UR 457,127. 15 Jan 1975. Filed date 23 Sep 1963. 103p.
Anodes of improved quality;patent. SILVER-ZINC BATTERIES;ANODES;FABRICATION;PVA

3749 BATTERY PLATE GRIDS. Barnes, S.C.; Barratt, K. (to Lucas, Joseph Industries, Ltd.). British Patent 1,380,901. 15 Jan 1975. Filed date 15 May 1971. 4p.
Patent; fabrication method. ELECTRIC BATTERIES;LEAD-ACID BATTERIES;LEAD;GLASS;FIBERS; PVC;PLATES;GRIDS;FABRICATION

3750 NICKEL-BASE ELECTRODES FOR ALKALINE BATTERIES. Mukunoki, J.; Shinoda, Y.; Kawashima, K. (to Matsushita Electric Industrial Co., Ltd.). Japanese Patent 2,137. 10 Jan 1975. Filed date 15 May 1973. 3p.
Patent; preparation procedure. ELECTRODES; NICKEL;SUBSTRATES;CHEMICAL PREPARATION;NICKEL-CADMIUM BATTERIES;IRON-NICKEL BATTERIES;NICKEL-ZINC BATTERIES;ELECTRIC BATTERIES

3751 METAL LATTICE FOR ELECTROLYTE SUPPORTS OF STORAGE BATTERIES. Kamijo, E.; Yazu, S. Japanese Patent 2,132. 10 Jan 1975. Filed date 15 May 1973. 3p.
Patent; Pb or alkaline storage batteries. ELECTRODES;ELECTRIC BATTERIES;SUPPORTS;TITANIUM NITRIDES;NICKEL;FOAMS;COATINGS;CHEMICAL PREPARATION

3752 ANODE COLLECTORS FOR ZINC ALKALINE BATTERIES. Tsuburaya, Y. (to Hitachi Maxell, Ltd.). Japanese Patent 2,136. 10 Jan 1975. Filed date 15 May 1973. 4p.
Patent; fabrication as coated Fe nets. NICKEL-ZINC BATTERIES;SILVER-ZINC BATTERIES; ZINC OXIDES;CALCIUM HYDROXIDES;ANODES;ZINC-AIR BATTERIES;ZINC-CHLORINE BATTERIES;ELECTRIC BATTERIES

3753 ELECTRICAL CONDUCTIVITY INCREASING AGENT FOR POSITIVE ELECTRODE MIX OF SODIUM--SULFUR FUEL CELLS. Hirai, T. (to Yuasa Battery Co., Ltd.). Japanese Patent 2,126. 10 Jan 1975. Filed date 14 May 1973. 3p.
Patent; C cloth of 1.2 percent graphitization, 300 W/kg. SODIUM-SULFUR BATTERIES;CATHODES;ELECTRIC CONDUCTIVITY

3754 LIGHTWEIGHT ELECTRODES FOR BATTERIES. Limmeroth, O. German(FRG) Patent 2,330,519. 9 Jan 1975. Filed date 15 Jun 1973. 3p.
LEAD-ACID BATTERIES;ELECTRODES;LEAD;ANODES; LAYERS;PLASTICS;FABRICATION

3755 NICKEL HYDROXIDE CATHODES FOR STORAGE BATTERIES. Gutjahr, M.A.; Schmid, R.; Beccu, K.D. (to Battelle Memorial Inst.). German(FRG) Patent 2,427,422. 9 Jan 1975. Filed date 7 Jun 1973. 19p.
Patent; fabrication. CATHODES;NICKEL HYDROXIDES;FABRICATION;ELECTRIC BATTERIES; NICKEL-CADMIUM BATTERIES;NICKEL-ZINC BATTERIES; IRON-NICKEL BATTERIES

3756 NICKEL HYDROXIDE CATHODES FOR STORAGE BATTERIES. Gutjahr, M.A.; Schmid, R.; Beccu, K.D. (to Battelle Memorial Inst.-International Division). German(FRG) Patent 2,427,421. 9 Jan 1975. Filed date 7 Jun 1973. 15p.
Patent; fabrication. NICKEL-ZINC BATTERIES; CATHODES;NICKEL HYDROXIDES;CELLULOSE; POLYETHYLENE GLYCOLS;HEATING;VERY HIGH TEMPERATURE;FABRICATION;CHEMICAL PREPARATION; IRON-NICKEL BATTERIES;NICKEL-CADMIUM BATTERIES; ELECTRIC BATTERIES

3757 SODIUM OR POTASSIUM ION-PERMEABLE SEPARATOR. Chiku, T.; Ninomiya, K.; Hayashi, H. (to Toyota Central Research and Development Labs., Inc.). Japanese Patent 435. 9 Jan 1975. Filed date 7 Mar 1970. 7p.
BATTERY SEPARATORS;FABRICATION;ION EXCHANGE MATERIALS;SODIUM IONS;POTASSIUM IONS;ALUMINIUM OXIDES;SODIUM OXIDES;POTASSIUM OXIDES;VERY HIGH TEMPERATURE;SINTERED MATERIALS

3758 BETA-ALUMINA SOLID ELECTROLYTE. Terazaki, M. (to Japan Storage Battery Co., Ltd.). Japanese Patent 436. 9 Jan 1975. Filed date 10 Apr 1970. 2p.
Patent; preparation. ALUMINIUM OXIDES; ELECTROLYTES;SODIUM-SULFUR BATTERIES;PRESSING; MAGNESIUM OXIDES;POLYETHYLENES;SINTERING;VERY HIGH TEMPERATURE;ELECTRIC CONDUCTIVITY

3759 ALKALINE BATTERY CATHODE. Kaneda, Y.; Naito, M.; Ohyama, K. (to Ray-O-Vac Co., (Japan) Ltd.). Japanese Patent 1,327. 8 Jan 1975. Filed date 11 May 1973. 4p.
Patent; Zn amalgam/KOH/$Ag_2O$. SILVER-ZINC BATTERIES;CATHODES;PERFORMANCE;SILVER OXIDES; GRAPHITE;POLYSTYRENE;TITANIUM OXIDES;CEMENTS; MOLDING;ZINC ALLOYS;MERCURY ALLOYS;POTASSIUM HYDROXIDES

3760 CADMIUM--ANTIMONY--LEAD ALLOY. Mao, G.W. (to Gould, Inc.). US Patent 3,859,084. 7 Jan 1975. Filed date 17 Jul 1969. 4p.
2.0 to 2.5 percent Sb, 2.0 to 4.0 percent Cd, increased tensile strength. LEAD BASE ALLOYS;CADMIUM ALLOYS;ANTIMONY ALLOYS;GRIDS; ELECTRIC BATTERIES;LEAD-ACID BATTERIES;ELECTRIC CABLES;CANNING

3761 CARBON-COATED ZINC ELECTRODE FOR LAMINATED BATTERIES. Hosoi, S.; Kuwazaki, M.; Yamaura, K.; Takano, Y. (to Matsushita Electric Industrial Co., Ltd.). Japanese Patent 102. 6 Jan 1975. Filed date 2 Oct 1968. 3p.
ELECTRIC BATTERIES;ELECTRODES;ZINC;CARBON; GRAPHITE;COATINGS;SLURRIES;LAMELLAE;EPOXIDES; RESINS;POLYAMIDES;BAKING

3762 BATTERY ELECTRODES. Benczur-Urmossy, G.; Baumeyer, U. (to Deutsche Automobilgesellschaft m.b.H.). GE 2,327,931. 2 Jan 1975. Filed date 1 Jun 1973. 23-7p.
Patent; preparation of Ni oxide, Ni hydroxide, and Fe oxide electrodes. NICKEL OXIDES;NICKEL HYDROXIDES;IRON OXIDES;IRON-NICKEL BATTERIES;NICKEL-CADMIUM BATTERIES; NICKEL-ZINC BATTERIES;CHEMICAL PREPARATION; ELECTRODES;ELECTRIC BATTERIES

3763 OXYGEN ELECTRODES. Meadowcroft, D.B.; Roscoe, C. (to Central Electricity Generating Board). British Patent 1,379,383. 2 Jan

1975. Filed date 29 Sep 1970. 10p.
Patent; 2-phase La--Sr cobaltites, fabrication. ZINC-AIR BATTERIES;OXYGEN;CATHODES; FABRICATION;LANTHANUM OXIDES;STRONTIUM CARBONATES;COBALT CARBONATES;VERY HIGH TEMPERATURE;STRONTIUM OXIDES;COBALT OXIDES

3764 LEAD--CALCIUM--ALUMINUM ALLOY FOR BATTERY GRIDS. Beasley, M.T. (to Lucas, Joseph, (Batteries) Ltd.). German(FRG) Patent 2,427,300. 2 Jan 1975. Filed date 6 Jun 1973. 9p.
LEAD-ACID BATTERIES;GRIDS;LEAD BASE ALLOYS; CALCIUM ADDITIONS;ALUMINIUM ADDITIONS;CASTING; FABRICATION;CALCIUM

3765 POROUS-ELECTRODE THEORY WITH BATTERY APPLICATIONS. Newman, J. (Lawrence Berkeley Lab., CA); Tiedemann, W. AIChE J.; 21: No. 1, 25-41(Jan 1975).
Porous-electrode theory with applications to batteries (and fuel cells). ELECTRODES; ELECTROCHEMISTRY;MASS TRANSFER;OPERATION; ELECTRIC BATTERIES;FUEL CELLS

3766 ELASTOMER-BONDED ZINC DUST ELECTRODES USED FOR HIGH-RATE SECONDARY ZINC--SILVER OXIDE BATTERIES. Moden, J.R. (Nav Underwater Syst Cent, Newport, RI). Rubber Age (N.Y.); 107: No. 1, 52-53(Jan 1975).
The zinc--silver oxide cell has a higher energy density than any other commercially available secondary (rechargeable) cell. However, the cell is expensive; therefore, it is worthwhile to investigate and upgrade the weaker components. In this regard, an area of recent study at the Naval Underwater Systems Center (NUSC) has been the electrodes and their individual contributions to the cell. In this brief report the results are presented under the following headings: zinc electrode less stable; fabrication method; and independent research fund to extend the cycle life of zinc-silver oxide cells. This additional cycle life can be translated directly into higher reliability of batteries and into dollars saved.

3767 MODEL FOR DEGRADATION OF CERAMIC ELECTROLYTES IN NA--S BATTERIES. Richman, R.H.; Tennenhouse, G.J. (Ford Motor Co., Dearborn, MI). J. Am. Ceram. Soc.; 58: No. 1-2, 63-67(1975).
From 75. annual meeting of the American Ceramic Society; Cincinnati, OH (1 May 1973).
SODIUM-SULFUR BATTERIES;ELECTROLYTES; ELECTROLYSIS;CRACKS;CAPILLARY FLOW;STRESSES; FRACTURE PROPERTIES;CERAMICS;ALUMINIUM OXIDES; BATTERY CHARGING

3768 LEAD DIOXIDE AS A SOLUBLE ELECTRODE. Beck, F.; Boehm, H. (Hauptlaboratorium der BASF Aktiengesellschaft,67 Ludwigshafen/Rhein). Ber. Bunsenges. Phys. Chem.; 79: No. 3, 233-44(1975). (In German).
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Specific surface, exchange current, and activation energy were measured on hydrogen electrodes on Ni that was prepared by a special method. (RWR)

3819 EFFECT OF THE INERT COMPONENT ON MASS TRANSFER IN THE GAS PHASE OF A POROUS ELECTRODE. II. OXYGEN ELECTRODE. Kicheev, A.G.; Luzhin, V.K.; Korovin, N.V. (Moscow Engineering Inst.). Elektrokhimiya; 11: No. 6, 946-949(1975). (In Russian).
Characteristic features of the operation of a carbon hydrophobized electrode were investigated, and experimental results relating to earlier theoretical calculations were obtained. Good agreement was found throughout the entire concentration range for an oxygen gas-diffusion electrode operating with nitrogen-

-oxygen mixtures. Changes in the diffusion coefficient for O in the gas phase were ascribed to electrocapillary processes, changes in concentrations of liquid and gas in the electrode or to effects of ohmic losses (not considered in the calculations), inter alia. Hydrophobization of the surface may lead to changes in the ratio of gas porosity to liquid porosity. (RWR)

3820 SUBSTRATE MATERIALS FOR PLATINIZED ANODES. Jacob, W.R. (Marston Excelsior Ltd., Wolverhampton, Eng.). Corros. Prev. Control; 22: No. 4, 6-20(1975).
The use of Ta, Ti, and Zr as substrate materials for platinized anodes is discussed. (RWR)

3821 DISTINGUISHING FEATURES OF DIFFERENT TYPES OF ANODES. Weiner, R. Galvanotechnik; 66: No. 9, 717-718(1975).
ELECTRIC BATTERIES;ANODES;REVIEWS

3822 KINETICS OF ANODIC LEAD DISSOLUTION OF $H_2SO_4$. Fleming, A.N.; Harrison, J.A.; Thompson, J. (Univ. of Newcastle upon Tyne, Eng.). pp 1-14 of Power sources 5. Collins, D.H. (ed.). New York; Academic Press Inc. (1975).
From 9. international power sources symposium; Brighton, UK (17 Sep 1974).
See CONF-740908--.
The fundamental electrochemistry of dissolution of lead in sulphuric acid has been investigated. The effect of dissolved oxygen on the dissolving species and on the lead surface is reported. The effects are unexpected.

3823 RECENT DEVELOPMENTS IN THE NRL--ILZRO INVESTIGATION OF THE POROUS $PBO_2/PBSO_4$ ELECTRODE. Simon, A.C.; Caulder, S.M. (Naval Research Lab., Washington, DC). pp 109-122 of Power sources 5. Collins, D.H. (ed.). New York; Academic Press Inc. (1975).
From 9. international power sources symposium; Brighton, UK (17 Sep 1974).
See CONF-740908--.
Studies of the positive active material with nuclear magnetic resonance, differential thermal analysis, optical and scanning electron microscopy and mass spectrography have revealed that an electrochemically inactive form of $PbO_2$ is present in the charged plate. This material does not take part in the discharge process. The presence of this material seems to be responsible for the appearance of the reticulate structure that accompanies the presence of tetrabasic lead sulfate crystals in the paste. It may also be necessary for the formation of the coralloid structure, described in this paper, that slowly develops in the plates during cycling. The presence of this inactive form of $PbO_2$ may be responsible for the poor active material utilization in the lead acid battery, and it has been found that its continued formation during cycling operation contributes to capacity loss.

3824 GASSING RATES OF AUTOMOTIVE BATTERIES. Haworth, D.J.; Peters, K.; Throw, J.S. (Chloride Technical Ltd., Clifton, Manchester). pp 123-137 of Power sources 5. Collins, D.H. (ed.). New York; Academic Press Inc. (1975).
From 9. international power sources symposium; Brighton, UK (17 Sep 1974).
See CONF-740908--.
Batteries assembled with grids made from three types of lead alloy were tested on shallow cycle/overcharge routines. At intervals the batteries were overcharged extensively from a potentiostatically regulated alternating current source and the gas losses and equivalent water losses were measured. The overcharges were carried out at three different temperatures. The high water losses at elevated temperature and the significant effect of grid alloy are illustrated. An assessment of various batteries under simulated service conditions shows the difficulties involved in operation of maintenance-free batteries without suitable temperature compensation.

3825 PERIODIC OBSERVATION OF THE SAME PIN-POINT OF BATTERY PLANTS WITH THE SCANNING ELECTRON MICROSCOPE. Hattori, S.; Yamaura, M.; Kohno, M.; Ohtani, Y.; Yamane, M.; Naskashima, H. (Yuasa Battery Co., Ltd., Osaka). pp 139-153 of Power sources 5. Collins, D.H. (ed.). New York; Academic Press Inc. (1975).
From 9. international power sources symposium; Brighton, UK (17 Sep 1974).
See CONF-740908--.
A method has been established to observe periodically the same pin-point of the electrode surface of the lead--acid battery by preparing a special electrode to fit in the specimen holder of the scanning electron microscope. This method was applied in a research program to study the reaction mechanism of the lead--acid battery electrode. As a result, the state of dissolution of $PbO_2$ crystals of the positive electrode and sponge lead of the negative electrode as well as the growth of $PbSO_4$ crystals of both electrodes during discharge was observed. The processes of $PbSO_4$ dissolution on both electrodes, also precipitation of $PbO_2$ crystals on the positive electrode and sponge lead on the negative electrode, during charge were observed.

3826 ELECTROCHEMICAL BEHAVIOR OF THE LEAD DIOXIDE ELECTRODE. Pohl, J.P.; Rickert, H. (Univ., Dortmund, Ger.). pp 15-22 of Power sources 5. Collins, D.H. (ed.). New York; Academic Press Inc. (1975).
From 9. international power sources symposium; Brighton, UK (17 Sep 1974).
See CONF-740908--.
The $PbO_2$ electrode is treated from the thermodynamic and kinetic point of view as a nonstoichiometric oxide electrode. It is shown that at least two partial currents have to be considered, that of lead ions and that of oxygen ions. During anodic polarization of a $PbO_2$ electrode, initially lead is dissolved and oxygen deposited, resulting in a change of stoichiometry of the lead dioxide. During cathodic polarization the opposite is the case. Only these deviations of the stoichiometry make it possible that under stationary state conditions lead and oxygen are dissolved or deposited in the absolute ratio 1 : 2 according to the stoichiometric formula.

3827 KINETICS OF THE $PBSO_4/PBO_2$ ELECTRODE AT LOW TEMPERATURES. Vareriote, E.M.L.; Gallop, L.D. (Defence Research Establishment, Ottawa). pp 55-71 of Power sources 5. Collins, D.H. (ed.). New York; Academic Press Inc. (1975).
From 9. international power sources symposium; Brighton, UK (17 Sep 1974).
See CONF-740908--.
Direct and alternating current potentiostatic and potentiodynamic measurements were applied to the study of lead dioxide formation in sulphuric acid at temperatures from -50°C to 0°C. The initial oxidation reaction kinetics were found to be controlled by two-dimensional nucleation and growth,

followed by diffusion through the completed surface layer. From the model and derived results, the heights of the nuclei were determined as a function of temperature and applied potential, and from both the linear scan voltammetry and potential-step methods the diffusion parameters of the rate controlling step were obtained. These results permit an improved description of the sequential anodic oxidation processes.

3828 EFFECTS OF METALLURGICAL STRUCTURE ON HYDROGEN EVOLUTION ON LEAD ALLOYS. Caldwell, T.W.; Sokolov, U.S. (NL Industries, Hightstown, NJ). pp 73-95 of Power sources 5. Collins, D.H. (ed.). New York; Academic Press Inc. (1975).
From 9. international power sources symposium; Brighton, UK (17 Sep 1974).
See CONF-740908--.
The rate of hydrogen evolution at constant composition on Pb--Sb, Pb--Ca, and Pb--Ca--Sn alloys was determined as a function of solidification parameters and hence of the microstructure. In all cases the rate of gassing decreased with increasing cooling rate. Heat treatments were employed to separate the influence of individual microstructural features. The relationships between solidification conditions and microstructure and between over-voltage and microstructure are discussed. The effect is believed to be of a general nature applying to other alloy systems as well as to other electrode reactions.

3829 NEW BATTERY STATE-OF-CHARGE INDICATOR ESPECIALLY FOR USE IN ELECTRIC VEHICLES. Bader, C. (Deutsche Automobilgesellschaft mbH, Esslingen, Ger.). pp 155-165 of Power sources 5. Collins, D.H. (ed.). New York; Academic Press Inc. (1975).
From 9. international power sources symposium; Brighton, UK (17 Sep 1974).
See CONF-740908--.
To indicate the available energy supply of electrochemical storage batteries, a measuring unit has been developed which indicates the behavior of the energy source during charging and discharging by simulating the essential physical characteristics, for which purpose the unit employs measurable quantities such as voltage, current and the temperature of the energy source. The numerical data of the simulated functions refer to a lead--acid battery, but the unit can be equally well employed for other types of batteries by changing coefficients appropriately.

3830 INVESTIGATIONS INTO THE MECHANISM OF CAPACITY LOSS BY POROUS CADMIUM ELECTRODES DURING CYCLING. Barnard, R.; Lee, J.A.; Rafinski, A.H.; Tye, R.L. (Every Ready Co., Ltd., London). pp 183-209 of Power sources 5. Collins, D.H. (ed.). New York; Academic Press Inc. (1975).
From 9. international power sources symposium; Brighton, UK (17 Sep 1974).
See CONF-740908--.
Loss of capacity of porous cadmium electrodes during cycling is confirmed. Chemical analysis establishes that the substantial losses experienced in early cycling are due both to the presence of residual cadmium after discharge and residual $Cd(OH)_2$ after charge, with the former being the major effect. The rate of loss decreases with charge rate but, revealingly, is independent of discharge rate. The techniques of linear sweep voltammetry and microscopy show that, on cycling, cadmium migrates toward the outer surfaces of the electrode and increases considerably in crystallite size. The failure mode proposed is coverage of cadmium surface by precipitated $Cd(OH)_2$ which induces passivation by a solid-state mechanism. The increase of residual cadmium on cycling is due to the increased cadmium crystallite size yielding less area to be blocked and to the confinement of cadmium to a smaller volume making blocking of the surface more probable.

3831 NEW TYPE OF INORGANIC SEPARATOR FOR ALKALINE SILVER BATTERIES. Jonville, P. (Battelle, Geneva); Fresnel, J.M.; Bezaudun, J. pp 233-259 of Power sources 5. Collins, D.H. (ed.). New York; Academic Press Inc. (1975).
From 9. international power sources symposium; Brighton, UK (17 Sep 1974).
See CONF-740908--.
In alkaline batteries containing a silver electrode, breakdown occurs mostly because of unsuitable separators which are not sufficiently resistant to the strong oxidizing power of silver oxides. In order to overcome this drawback, a new type of inorganic separator for alkaline silver cells has been developed. This separator is prepared by directly plasma spraying a molten refractory oxide, such as zirconia, on the silver electrode. The porous layer obtained by this technique is closely adherent to the silver substrate, the structure of which has been particularly adapted to this purpose. Moreover, this membrane is chemically inert in potassium hydroxide solution and does not undergo any attack by silver oxide. The layers of zirconia are characterized by a high microporosity combined with a rather high tortuosity factor. The porosity, the specific resistivity in KOH and also the rate of silver transport through these layers have been determined as a function of the manufacturing parameters. Their ability to cut down the migration of silver from the positive to the negative electrode was measured in silver--cadmium cells and compared with that of Cellophane separators. The new inorganic separators give silver batteries a considerably increased lifetime due to greatly reduced deposition of metallic silver on the Cellophane separator, as a result of which the time before cell failure occurs by internal short-circuit increases.

3832 SECONDARY CELLS BASED ON REVERSIBLE HYDROGEN TRANSFER BETWEEN ELECTRODES CAPABLE OF ABSORBING LARGE VOLUMES OF HYDROGEN IN INTERSTITIAL SOLID SOLUTIONS. Lewis, F.A.; Witherspoon, M.C.; Obermann, A. (Queen's Univ., Belfast). pp 361-369 of Power sources 5. Collins, D.H. (ed.). New York; Academic Press Inc. (1975).
From 9. international power sources symposium; Brighton, UK (17 Sep 1974).
See CONF-740908--.
Several transition metals and their alloys absorb large volumes of hydrogen accompanied by formation of distinct hydride phases. These solids can retain a considerable measure of the electrical conductivity and cohesiveness of the metal: they are also characterized by a high internal hydrogen mobility. Over the range of hydrogen contents of phase transformations the virtually constant chemical potential of hydrogen is reflected by corresponding characteristic values of electrode potential. Pairs of electrodes with differing phase transformation potentials can constitute cells for which the sole overall chemical reaction during either charge or discharge can be the transfer of hydrogen from one electrode to the other.

3833 MAGNESIUM ALLOYS FOR ANODES IN ALKALINE-ELECTROLYTE POWER SOURCES. Wiesener, K.; Glaeser, W.; Pelz, R. (Technische Univ., Dresden). pp 425-446 of Power sources 5. Collins, D.H. (ed.). New York; Academic Press Inc. (1975).
From 9. international power sources symposium; Brighton, UK (17 Sep 1974).
See CONF-740908--.
In our laboratory, tests were made on magnesium and magnesium alloys as to their qualifications for metal--air elements with alkaline electrolytes. Magnesium was alloyed with aluminium, zinc, lead, thallium, mercury and lithium. As the electrolyte, a 5 M $NaClO_4$ solution was used to which varying amounts of NaOH were added. Various methods of measurement and analysis methods were used for the characterization of the anode materials employed: 1. Galvanostatic measurements; 2. Delta voltage method; 3. Determination of the corrosion rates before, during and after electrochemical loading; and 4. Examination of complete metal--air cells.

3834 ANODIC BEHAVIOUR OF INDIUM AND INDIUM/BISMUTH ALLOYS IN ALKALINE SOLUTIONS. Armstrong, R.D.; Dickinson, T.; MacFarlane, B.; Thirsk, H.R. (Univ. of Newcastle upon Tyne, Eng.). pp 479-502 of Power sources 5. Collins, D.H. (ed.). New York; Academic Press Inc. (1975).
From 9. international power sources symposium; Brighton, UK (17 Sep 1974).
See CONF-740908--.
In KOH and NaOH solutions, indium undergoes anodic dissolution at potentials more positive than -1.16 V. The Tafel slope for this process is about 26 mV/decade and the order of reaction with respect to hydroxide ion is 3. A mechanism for this reaction is proposed. Three types of passivating layer are produced; in the sequence $In(OH)_3$, InOOH and $In_2O_3$ at progressively more positive potentials. The first layer is porous and not very protective but $In_2O_3$ is highly protective and difficult to reduce. The presence of bismuth reduces the passivating properties of these layers and especially those of $In_2O_3$.

3835 SULPHATE BASED SOLID ELECTROLYTES WITH SOME APPLICATIONS. Heed, B.; Lunden, A. (Chalmers Univ. of Tech., Gothenburg, Sweden). pp 573-579 of Power sources 5. Collins, D.H. (ed.). New York; Academic Press Inc. (1975).
From 9. international power sources symposium; Brighton, UK (17 Sep 1974).
See CONF-740908--.
There exist a number of systems with sulphate as the sole or main anion in which cations have a high mobility. For binary sulphate systems highly conducting phases can be found down to at least 415°C. If additional components are added conductivities exceeding $10^{-3}$ $\Omega$ $cm^{-1}$ can be obtained at ambient temperatures. A $Mg/Li_{1.72}Mg_{0.14}SO_4/MnO_2$ cell gave an open-circuit cell voltage of 2.5 V and a power density of 0.3 $W/cm^3$ at 650°C. At ambient temperatures $Ag/electrolyte/I_2$ cells can be run in air without any precautions to remove moisture. Although the conductivity is much less than for $RbAg_4I_5$, the current-voltage curves obtained seem to be comparable with curves reported for $RbAg_4I_5$ cells.

3836 SCANNING ELECTRON MICROSCOPIC STUDIES OF LITHIUM AND CYCLE BEHAVIOR OF LITHIUM NONAQUEOUS CELLS WITH TRANSITION METAL CHALCOGENIDE CATHODES. Broadhead, J.; Trumbore, F.A. (Bell Labs., Murray Hill, NJ). pp 661-682 of Power sources 5. Collins, D.H. (ed.). New York; Academic Press Inc. (1975).
From 9. international power sources symposium; Brighton, UK (17 Sep 1974).
See CONF-740908--.
Rechargeability studies of cells employing cathodes of $NbSe_3$, $NbS_3$, $TaSe_3$, and $TiS_3$ in 1 M $LiClO_4$ in propylene carbonate are discussed. All systems show rechargeability and, with the exception of $TiS_3$, cell failures are related to lithium anode morphology changes. Preliminary scanning electron micrographs of lithium electrodes are presented together with associated chronopotentiograms of lithium electrodeposition on metal substrates. On cycle, with selected electrolytes, completely smooth surfaces of lithium are observed for several cycles while 10 cycles densely packed crystalline lithium is observed. Cycle experiments with lithium anodes in contact with 0.6 M tetrabutylammonium iodide in 1.0 M lithium perchlorate in propylene carbonate exhibited 130 cycles at approximately 50 percent depth of cathode discharge compared with about 90 cycles at 25 percent depth of discharge when 1 M lithium perchlorate in propylene carbonate was used as electrolyte.

3837 STUDIES ON THE SILVER/SILVER OXIDE ELECTRODE. Sasaki, H.; Toshima, S. (Tohok Univ., Japan). Electrochim. Acta; 20: 201-207(1975).
The electrochemical behavior of silver/silver oxide electrodes in 1 N KOH or 1 N KOH + methanol was studied by measuring current--potential and impedance--potential curves under the potential sweep in the cathodic direction starting from the AgO formation region. Two specific anodic current peaks A and X were observed in current--potential curves. It was concluded that X was due to the incomplete oxidation of $Ag_2O$ to AgO under the anodic sweep or due to the partial decomposition of AgO layer, and A was due to the catalytic reaction of AgO with methanol followed by the electrochemical oxidation of $Ag_2O$ to AgO. The values of the impedance tend to decrease in the vicinity of the peak A at the low frequency, which decrease may be attributed to the reduction of AgO with methanol. 16 figures, 2 tables.

3838 ELECTROCHEMISTRY OF BETA-$MNO_2$ AND $\gamma$-$MNO_2$ IN ALKALINE ELECTROLYTE. McBreen, J. (General Motors Corp., Warren, MI). Electrochim. Acta; 20: 221-225(1975).
The electrochemical reactions of BETA-$MnO_2$ and $\gamma$-$MnO_2$ in 7 M KOH were studied by using low-rate linear sweep voltammetry (approx. =25 $\mu$V/s) in conjunction with x-ray analysis of the reaction products. The reduction of BETA-$MnO_2$ differs from that of $\gamma$-$MnO_2$ in that there is no dilation of the BETA-$MnO_2$ crystal lattice and $Mn_3O_4$ (hausmannite) is formed. The irreversibility of $\gamma$-$MnO_2$ electrodes is related to the formation of $Mn(OH)_2$. Manganese hydroxide is oxidized to delta-$MnO_2$, and delta-$MnO_2$ forms $Mn_3O_4$ on reduction. Hausmannite resists electrochemical oxidation. Poorly crystallized $\gamma$-MnOOH is formed as an intermediate in the oxidation of $Mn(OH)_2$. The formation of $Mn_3O_4$ is discussed in terms of the potential-pH diagram for manganese oxides and the thermodynamic properties of MnOOH. 4 figures, 2 tables.

3839 SILVER/SILVER-OXIDE ELECTRODE. II. INFLUENCE OF A SUPERIMPOSED SINUSOIDAL POTENTIAL ON THE ANODISING OF SILVER. Dyer, C.K.; Hoar, T.P. (Univ. of Cambridge, Eng.). Electrochim. Acta; 20: 161-171(1975).
When silver is anodized in 1 M KOH with

certain amplitudes up to 1 V peak-to-peak of sinusoidal potential (55 Hz) about mean potentials ranging from 0.62 to 1.04 V (nhe), the subsequent reduction capacities are up to 30 times larger than those obtained after potentiostatic anodizing for the same time. At higher frequencies (220 1100 Hz) conditions leading to large reduction capacities are less dependent on the amplitude of the sinusoidal component. Partial reduction at each cycle and fast oxidation and reduction reactions are suggested as responsible for the large amounts of overall oxidation of the silver electrodes. 21 figures.

3840 SILVER/SILVER-OXIDE ELECTRODE. III. ANODISING OF SILVER WITH ASYMMETRIC SINUSOIDAL CURRENT. Dyer, C.K.; Hoar, T.P. (Univ. of Cambridge, Eng.). Electrochim. Acta; 20: 173-177(1975).

The anodizing of silver in 1 M KOH with ac superimposed on dc of between 1 and 5 mA/cm$^2$ produces large amounts of silver oxide when the ratio of ac (mA peak-to-peak) to dc (mA) is 48 : 1 thought to correspond to the conditions under which large discharge capacities are obtained after anodizing with certain amplitudes of superimposed sinusoidal potential. 11 figures.

3841 CONDUCTIVE CERAMICS FOR USE IN THE SODIUM--SULFUR BATTERY. Whalen, T.J. (Ford Motor Co., Dearborn, MI). SAE J.; vp.(1975).

$Al_2O_3$ with 8.5 to 10% $Na_2O$ and 0.6 to 1.1% $Li_2O$. CERAMICS;ALUMINIUM OXIDES;SODIUM OXIDES; LITHIUM OXIDES;SODIUM-SULFUR BATTERIES; ELECTROLYTES;MECHANICAL PROPERTIES;ELECTRICAL PROPERTIES;SINTERING;IONIC CONDUCTIVITY

3842 CARBON AIR ELECTRODE WITH REGENERATIVE SHORT TIME OVERLOAD CAPACITY. II. EFFECTS OF DUROQUINONE AND 2-AMINO-1,4-NAPHTHOQUINONE. Zoltowski, P.; Drazic, D.M.; Vorkapic, L. (Univ. of Belgrade). J. Appl. Electrochem.; 5: No. 1, 79-87(1975).

The carbon-air electrode in a strongly alkaline electrolyte was investigated. It was found that the short-time overload capacity could be increased by adding organic substances such as duroquinone or 2-amino-1,4-naphthoquinone. The latter is quite stable, even in concentrated potassium hydroxide. Small amounts of both substances had a catalytic effect on oxygen reduction at the electrode. (RWR)

3843 PHASE COMPOSITION OF NEGATIVE PASTES OF LEAD STORAGE BATTERIES. Kurochkina, V.V.; Makhalov, N.A.; Rusin, A.I. Sb. Rab. Khim. Istochnikam Toka; 10: 90-95(1975). (In Russian).

The phase composition of several common anode pastes was studied. The principal phases present were tetragonal PbO and 3 PbO . $PbSO_4$ . $H_2O$. The effects of drying on the phase ratio and the strength of the active mass were noted. (RWR)

3844 USE OF LEAD STORAGE BATTERIES AT LOW TEMPERATURES. Yampol'skaya, E.G.; Smirnova, I.A.; Biryuk, K.I.; Parshikova, E.V.; Kalish, A.F. Sb. Rab. Khim. Istochnikam Toka; 10: 74-82(1975). (In Russian).

The effects of surfactants and inhibitors on the behavior of lead--acid battery electrodes were studied at -20 to -50°. Additives used were tanning agents No. 4, BNS, and BNF; sodium and calcium lignosulfonate; humic acid; and α-hydroxynaphthoic acid. It was found that tanning agents No. 4 and BNF and calcium lignosulfonate had desirable effects on the discharge properties of the battery anode. (RWR)

3845 INTERACTION OF A SILVER OXIDE ELECTRODE WITH A REGENERATED CELLULOSE SEPARATOR FILM IN SILVER--CADMIUM STORAGE BATTERIES. Molotkova, E.N.; Yarochkina, E.N. Zh. Prikl. Khim.; 48: No. 8, 1773-1778(1975). (In Russian).

The voltage of charged silver--cadmium batteries during storage at 35° was measured. Silver content in separators after four months of storage and the change in phase composition of the cathodes were also determined. (RWR)

3846 CURRENT TRENDS IN BATTERY SEPARATORS. Palmer, N.I. (W.R. Grace and Co., Cambridge, MA). pp 105-110 of Battery Council International convention: 1975. Chicago; Battery Council International (1975).

From 87. Battery Council International convention; Hollywood, Florida, USA (8 Apr 1975).

See CONF-7504129--.

The requirements which must be met by the separators in today's batteries and the materials being developed to meet these requirements are outlined. (RWR) 6 figures.

3847 MAINTENANCE FREE BATTERIES: EVOLUTION OR REVOLUTION. Young, J.A. Jr. pp 127-134 of Battery Council International convention: 1975. Chicago; Battery Council International (1975).

From 87. Battery Council International convention; Hollywood, Florida, USA (8 Apr 1975).

See CONF-7504129--.

The maintenance-free battery is regarded as both the product of an orderly evolutionary trend and the spawning ground for revolutionary developments in battery manufacturing processes. ''Maintenance-free'' is an evolutionary concept by virtue of the reduction of Sb in the grid alloy, introduction of non-antimonial Pb--Ca--Sn alloys, and improvements in conventional grid casting techniques. This yields either a low-maintenance or a maintenance-free product of relatively conventional shape and design. The use of non-antimonial alloys--specifically Pb--Ca--Sn alloys--has made possible the consideration of sheet lead as a grid material and has opened the possibilities of revolutionary high-speed manufacturing processes, battery designs, and performance characteristics. (RWR) 14 figures.

3848 TIN AND BISMUTH IN LEAD--CALCIUM ALLOY. Myers, M. (American Smelting and Refining Co., New York). pp 135-139 of Battery Council International convention: 1975. Chicago; Battery Council International (1975).

From 87. Battery Council International convention; Hollywood, Florida, USA (8 Apr 1975).

See CONF-7504129--.

Some metallurgical aspects of the Pb--Ca--Sn--Bi alloys system are discussed. Specifically, metallurgical aspects of Bi concentrations of up to 0.1% and tin up to 1% were examined. It is found that there is no need for Sn levels as high as 0.5 or 1%; Pb--0.06Ca alloy presents improvement in casting fluidity with the addition of as little as 0.1% Sn. It is suggested that improved alloys would result if tin concentrations were lowered and bismuth concentrations were raised. 7 figures. (RWR)

3849 LEAD CALCIUM GRID CASTING. Wirtz, J.W.

(Wirtz Manufacturing Co., Port Huron, MI). pp 140-141 of Battery Council International convention: 1975. Chicago; Battery Council International (1975).
From 87. Battery Council International convention; Hollywood, Florida, USA (8 Apr 1975).
See CONF-7504129--.
The casting of lead--calcium alloys into battery grids is briefly discussed. The alloys involved are lead with about 0.08% Ca and from 0.25 to 1% Sn. Hardness, oxidation rates, and melting and solidification temperatures are addressed. Casting machines have been developed which permit the fabrication of 60 grids in a minute. (RWR)

3850 BATTERY MATERIALS: PROGNOSIS AND SUPPLY. Kenny, R.J. (E.S.B. Inc., Philadelphia). pp 94-99 of Battery Council International convention: 1975. Chicago; Battery Council International (1975).
From 87. Battery Council International convention; Hollywood, Florida, USA (8 Apr 1975).
See CONF-7504129--.
Supplies of battery materials will probably be unpredictable. Supplies should be ample in the near future; demand will be much greater, however, in 25 or 30 years. One important uncertainty is the source of the capital needed for the requisite expansion of the supply industries. Another is the possibility of embargoes by producing nations. The battery materials considered in this review are lead, antimony, tin, arsenic, plastics, corrugated board materials, and sulfuric acid. (RWR) 9 figures.

3851 SOME ASPECTS OF THE CYCLING BEHAVIOR OF MAINTENANCE-FREE BATTERIES. Hein, E.R.; Parmar, J.K. (NL Industries, Hightstown, NJ). pp 142-144 of Battery Council International convention: 1975. Chicago; Battery Council International (1975).
From 87. Battery Council International convention; Hollywood, Florida, USA (8 Apr 1975).
See CONF-7504129--.
Lead from recycled scrap batteries is often used in the production of new batteries. The purpose of this work was to help establish what purity requirements are actually necessary. The experiments involved grid base metals made from two types of lead, refined secondary and low-bismuth primary; oxides made from three different types of lead, refined secondary, low-bismuth primary, and high-bismuth primary; and two types of construction, the familiar automotive construction and the semi-industrial construction. Various tests are described, and the following conclusions were reached. The source of the base lead, be it secondary or primary, used for either the grid or the oxide, has no bearing on the gassing of maintenance-free batteries. The source of base lead, secondary or primary, for either grid alloy or oxides, has no bearing on the performance of maintenance-free batteries during cycling. The semi-industrial construction improves the cycling performance of maintenance-free batteries. (RWR)

3852 MAGNESIUM AND MAGNESIUM ALLOYS AS ANODES IN ELECTROCHEMICAL ALKALINE-ELECTROLYTE POWER SOURCES. Wiesener, K.; Glaeser, W.; Pelz, R. (Technische Univ., Dresden). Wiss. Z. Tech. Univ. Dresden; 24: No. 1, 65-73(1975). (In German).
The possibilities of using magnesium and magnesium alloys in metal--air elements with alkaline electrolytes are examined. Magnesium alloys with aluminum, zinc, lead, thallium, mercury and lithium were investigated in this respect. A 5 M sodium perchlorate solution with different additions of caustic soda was used as the electrolyte. Different measurement and analysis methods were used to characterize the anode materials, namely galvanostatic measurements; potentiodynamic measurements; corrosion measurements before, during, and after anodic loading; investigation of complete metal--air cells.

3853 POWDER-METALLURGY ELECTRODE OF AN ALKALINE STORAGE BATTERY. Kloss, A.I.; Pozin, Yu.M.; Nikol'skii, V.A.; Demchenko, V.I.; Baranov, A.I. UR 455,402. 30 Dec 1974. Filed date 13 Aug 1973. 104p.
NICKEL COMPOUNDS;CARBONYLS;CATHODES;NICKEL-CADMIUM BATTERIES;NICKEL-ZINC BATTERIES;IRON-NICKEL BATTERIES;ELECTRIC BATTERIES;ELECTRODES; POWDER METALLURGY;SINTERING;CHEMICAL PREPARATION;FABRICATION

3854 REMOVAL OF CALCIUM IMPURITY FROM THE ELECTROLYTE OF AN ALKALINE STORAGE BATTERY WITH A CADMIUM ANODE. Kloss, A.I.; Nikol'skii, V.A.; Novoselova, V.D.; Baranov, A.I. UR 455,404. 30 Dec 1974. Filed date 28 Aug 1973. 105p.
NICKEL-CADMIUM BATTERIES;SILVER-CADMIUM BATTERIES;CALCIUM;IMPURITIES;ELECTROLYTES; PURIFICATION

3855 POSITIVE ELECTRODE FOR A BATTERY. Fateeva, N.I.; Lyamin, P.N.; Popova, Z.I.; Kocherginskii, M.D. (to Elets Element Plant). French Patent 2,232,092. 27 Dec 1974. Filed date 31 May 1973. 8p.
Patent; Mn-containing mineral, carbon black, and polyethylsiloxane-impregnated C. CATHODES; CARBON BLACK;MANGANESE;HYDROXIDES;TOLUENE; SILOXANES;ORGANIC POLYMERS;ELECTRIC BATTERIES; CHEMICAL PREPARATION

3856 BATTERY SEPARATOR MANUFACTURING PROCESS. Palmer, N.I.; Sugarman, N. (to W.R. Grace and Co.). US Patent 3,933,525. 27 Dec 1974. vp.
A battery with a positive plate, a negative plate, and a separator of polymeric resin having a degree of undesirable hydrophobia, solid below 180°F, extrudable as a hot melt, and resistant to degradation by at least either acids or alkalies positioned between the plates is described. The separator comprises a nonwoven mat of fibers, the fibers being comprised of the polymeric resin and a wetting agent in an amount of 0.5 to 20 percent by weight based on the weight of the resin with the amount being incompatible with the resin below the melting point of the resin such that the wetting agent will bloom over a period of time at ambient temperatures in a battery, yet being compatible with the resin at the extrusion temperature and bringing about blooming to the surface of the fibers when the fibers are subjected to heat and pressure.

3857 BIPOLAR BATTERY ELECTRODES BASED ON THE SYSTEM METAL OXIDE--METAL. Pospelov, B.A.; Raikhel'son, L.B.; Fedotova, A.S.; Nikol'skii, V.A.; Efimova, V.A. USSR Patent 454,612. 25 Dec 1974. Filed date 12 Feb 1973.
Patent; preparation of such as Pb oxide--Pb. LEAD-ACID BATTERIES;ELECTRODES;CHEMICAL PREPARATION;LEAD OXIDES;LEAD

3858 AUXILIARY ELECTRODE FOR ALKALINE NICKEL--CADMIUM STORAGE BATTERY SEALED HERMETICALLY. Pozin, Yu.M.; Miroshnichenko, A.S.; Zolotov, A.I.; Nikol'skii, V.A. USSR Patent 454,613. 25 Dec 1974. Filed date 24 Jan 1973.
NICKEL-CADMIUM BATTERIES;ELECTRODES;SEALS; HYDROXIDES;FABRICATION;ACTIVATED CARBON;NICKEL CARBONATES

3859 METHOD FOR MANUFACTURING LEAD GRID PLATES FOR BATTERIES. Tsuda, N. (to Furukawa Electric Co., Ltd.). US Patent 3,959,016. 24 Dec 1974. Priority date 26 Dec 1973, Japan. vp.
A method for manufacturing a lead grid plate having an outer frame portion for batteries consists of two steps: preparing a rolled lead alloy plate, measuring 0.5 to 1 mm in thickness, and press punching the rolled lead alloy plate by means of a metal mold to obtain a lead grid plate. The width of the grid-forming members of the plate measures about the same as the thickness of the plate. The second step is accomplished in at least two steps by press punching only voids at least in every alternate file or row or in a zig-zag line, then filling the lead grid plate with active material.

3860 FRAMEWORK FOR ELECTRODES IN ELECTRIC CELLS. Buehl, H. (to Deutsche Automobilgesellschaft mbH). German(FRG) Patent 2,327,885. 19 Dec 1974. Filed date 1 Jun 1973. 6p.
ELECTRIC BATTERIES;ELECTRODES;IRON;PYROLYSIS; NITROGEN;MOLDING;HEATING;SINTERING;HYDROGEN; IRON CARBONATES;HIGH TEMPERATURE;VERY HIGH TEMPERATURE

3861 GRANULAR ACTIVE MATERIAL FOR LEAD--ACID BATTERY ELECTRODES. Eckerbom, G.; Nilsson, O. (to Aktiebolag Tudor). German(FRG) Patent 2,427,152. 19 Dec 1974. Filed date 1 Jun 1973. 17p.
LEAD-ACID BATTERIES;TUBES;LEAD;LEAD OXIDES; ELECTRODES;FABRICATION

3862 DEVICE FOR INDICATING THE TEMPERATURE OF BATTERIES. Winsel, A. (to Varta Batterie AG). Belgian Patent 819,336. 16 Dec 1974. Filed date 13 Sep 1973. 10p.
ELECTRIC BATTERIES;TEMPERATURE MEASUREMENT; HEATING;PERFORMANCE

3863 REMOVAL OF CARBON DIOXIDE FROM AIR REQUIRED FOR FUEL CELLS. Kuehl, D. (to Siemens AG). German(FRG) Patent 2,326,070. 12 Dec 1974. Filed date 22 May 1973. 10p.
An apparatus for removing $CO_2$ from air for use in fuel cells or metal-air batteries is described. The $CO_2$ is removed by a KOH solution which is adsorbed on a set of parallel, corrugated, porous, sintered pvc plates. The pressure drop is about 10 $N/m^2$.

3864 HYDROPHILIC MICROPOROUS FILM. Taskier, H.T. (to Celanese Corp.). US Patent 3,853,601. 10 Dec 1974. Filed date 18 Apr 1972. 10p.
BATTERY SEPARATORS;POLYPROPYLENE;FILMS; GLYCOLS;ELECTRIC CONDUCTIVITY;CHEMICAL PREPARATION;SILICON COMPOUNDS;COPOLYMERIZATION; SURFACTANTS

3865 ADDITIVE FOR AN ALKALINE BATTERY USING DIVALENT SILVER OXIDE POSITIVE ACTIVE MATERIAL. Davis, S.M. (to ESB Inc.). US Patent 3,853,623. 10 Dec 1974. Filed date 24 Au 1971. 6p.
ELECTRIC BATTERIES;SILVER-ZINC BATTERIES; SILVER-CADMIUM BATTERIES;CATHODES;ADDITIVES; GOLD IONS;ELECTROLYTES;STABILITY;AQUEOUS SOLUTIONS;HYDROXIDES;SILVER;SILVER OXIDES; ELECTROCHEMISTRY;GOLD OXIDES;GOLD CHLORIDES; MERCURY OXIDES

3866 ZINC FIBERS AND NEEDLES AND GALVANIC CELL ANODES MADE THEREFROM. Louzos, D.V. (to Union Carbide Corp.). US Patent 3,853,625. 10 Dec 1974. Filed date 3 Apr 1970. 20p.
NICKEL-ZINC BATTERIES;SILVER-ZINC BATTERIES; FIBERS;ZINC;ANODES;FABRICATION;ELECTROLYSIS; LEAD OXIDES;ADDITIVES;ELECTRIC BATTERIES

3867 APPARATUS AND METHOD FOR MAKING EXPANDED METAL LEAD--ACID BATTERY GRIDS. Daniels, E. Jr.; Kline, R.H. (to General Motors Corp.). US Patent 3,853,626. 10 Dec 1974. Filed date 20 Sep 1973. 15p.
LEAD-ACID BATTERIES;GRIDS;LEAD;ANODES; FABRICATION

3868 CARBONYL NICKEL POWDER. Llewelyn, D.M. (to International Nickel Ltd.). GE 2,423,309. 5 Dec 1974. Filed date 15 May 1973. 12p.
Chemical preparation of B type. NICKEL-CADMIUM BATTERIES;NICKEL-ZINC BATTERIES;IRON-NICKEL BATTERIES;CATHODES;PLATES;CHEMICAL PREPARATION;SUPPORTS;CARBONYLS;NICKEL COMPOUNDS

3869 BONDING OF TWO RUBBER OR PLASTIC COMPONENTS. Navarre, I.L. British Patent 1,376,216. 4 Dec 1974. Filed date 12 May 1971. 8p.
SEALS;POLYPROPYLENE;CONTAINERS;ELECTRIC BATTERIES;BONDING;COPOLYMERIZATION;ACETIC ACID ESTERS;ETHYLENE;ESTERS

3870 POLY(VINYLIDENE FLUORIDE) MEMBRANES WITH FINE PORES. Yamao, J. (to Yuasa Battery Co., Ltd.). Japanese Patent 74,126,572. 4 Dec 1974. Filed date 9 Apr 1973. 3p.
PATENT. POLYVINYLS;FLUORINATED ALIPHATIC HYDROCARBONS;MEMBRANES;DMSO;ACETONE;ELECTRIC BATTERIES;BATTERY SEPARATORS

3871 ACTIVATION OF NICKEL BATTERY PLATES. Turner, T.S.; Whittle, J.E. (to International Nickel Co., Inc., New York, NY). US Patent 3,852,112. 3 Dec 1974. Filed date 8 Feb 1973. 4p.
Patent; electrolytic process. NICKEL-CADMIUM BATTERIES;NICKEL-ZINC BATTERIES;IRON-NICKEL BATTERIES;CATHODES;NICKEL;ELECTRIC BATTERIES; NICKEL COMPOUNDS;AMMONIA;AMMONIUM COMPOUNDS; SOLUTIONS;HYDROXIDES;CHEMICAL ACTIVATION;PLATES; CHEMICAL PREPARATION;NICKEL NITRATES;NITRATES

3872 LEAD STORAGE BATTERY CELL. Brinkmann, J.; Trippe, G. (to Varta Batterie Aktiengesellschaft, Hannover, Germany). US Patent 3,852,111. 3 Dec 1974. Filed date 23 Oct 1973. 6p.
Patent; plate design. LEAD-ACID BATTERIES; PLATES;ELECTRODES;DESIGN

3873 CATALYST SUITABLE FOR AN OXYGEN ELECTRODE. Tamura, H. (to Hitachi Maxell, Ltd.). Japanese Patent 45,069. 2 Dec 1974. Filed date 13 Dec 1969. 3p.
METAL-GAS BATTERIES;CATHODES;OXYGEN; CATALYSTS;SILVER OXIDES;SODIUM COMPOUNDS;

NITRITES;TEFLON

3874 PHASE EQUILIBRIUM DIAGRAM OF THE SYSTEM $NA_2S_4$--S. Coleman, D.S.; Heal, M. (Dept. Materials Technology, Univ. Technology, Loughborough, Leicestershire). Inst. Min. Metall., Trans., Sect. C; 83: C258-9(Dec 1974).
73 to 100 percent S. SODIUM-SULFUR BATTERIES; SODIUM SULFIDES;PHASE DIAGRAMS;SULFUR;MELTING POINTS;BATTERY SEPARATORS;CHEMICAL REACTIONS

3875 METAL--HALOGEN BATTERIES. Marchetto, M. (to Fabbrica Italiana Magneti Marelli S.p.A.). GE 2,414,877. 28 Nov 1974. Filed date 28 Mar 1973. 6p.
Protection of Ti electrodes against corrosion. METAL-GAS BATTERIES;ELECTRODES; TITANIUM;HALOGENS;COATINGS;CORROSION PROTECTION

3876 ELECTRODES FOR LEAD STORAGE BATTERIES. Jonville, P.; Stoehr, H.; Beccu, K.D. (to Battelle Memorial Inst.-International Division). German(FRG) Patent 2,406,796. 28 Nov 1974. Filed date 12 Feb 1973. 15p.
Patent; formation in glass fiber mat. LEAD-ACID BATTERIES;ELECTRODES;CHEMICAL PREPARATION; LEAD;LEAD ALLOYS;GLASS;FIBERS;LEAD OXIDES; CATHODES;ANODES

3877 BETA ALUMINA CERAMIC. Jones, I.W.; Miles, L.J. (to Electricity Council). UK 1,375,167. 27 Nov 1974. Filed date 29 Dec 1970. 9p.
Chemical preparation. SODIUM-SULFUR BATTERIES;ALUMINIUM OXIDES;ELECTROLYTES; CHEMICAL PREPARATION;SINTERING;SINTERED MATERIALS;CERAMICS;ALLOTROPY

3878 GAS ELECTRODES FOR ELECTROCHEMICAL CELLS. Sklarchuck, J.C. (to ESB Inc.). British Patent 1,375,514. 27 Nov 1974. Filed date 20 Jun 1973. 6p.
Patent; fabrication. ZINC-AIR BATTERIES; CATHODES;FABRICATION;NICKEL;POWDERS;OXIDATION; METHANE;CARBONIZATION;PERFORMANCE

3879 PROCESS FOR MAKING ELECTROCHEMICAL ELECTRODES. Brown, P.H.; Tremblay, M.H. (to Brunswick Corp.). US Patent 3,850,697. 26 Nov 1974. Filed date 12 Oct 1971. 6p.
ELECTRODES;FABRICATION;FUEL CELLS;ELECTRIC BATTERIES;FILAMENTS;METALS

3880 LOW PRESSURE NICKEL HYDROGEN CELL. Dunlop, J.D.; Earl, M.W.; Van Ommering, G. (to Communications Satellite Corp.). US Patent 3,850,694. 26 Nov 1974. Filed date 27 Nov 1972. 8p.
HYDROGEN STORAGE;NICKEL HYDRIDES;LANTHANUM HYDRIDES;SORPTIVE PROPERTIES;NICKEL-HYDROGEN BATTERIES;DESIGN;OPERATION;SEALS;GASES

3881 ELECTROCHEMICAL ELECTRODES. Brown, P.H.; Tremblay, M.H. (to Brunswick Corp.). US Patent 3,850,697. 26 Nov 1974. Filed date 25 Sep 1969. 6p.
ELECTRIC BATTERIES;ELECTRODES;FIBERS;METALS; ELECTROCHEMISTRY;CHEMICAL PREPARATION

3882 CATHODE FOR A ZINC--AIR BATTERY WITH FORCED CIRCULATION. Pompon, J.P.; Chevet, R. (to Compagnie Generale d'Electricite). French Patent 2,227,651. 22 Nov 1974. Filed date 20 Dec 1971. 11p.
Fabrication of electrode containing carbon black, Ag-containing activated carbon, and poly (tetrafluoroethylene). ZINC-AIR BATTERIES; CATHODES;CARBON BLACK;ACTIVATED CARBON;CHEMICAL PREPARATION;SINTERED MATERIALS;FABRICATION; SILVER;TEFLON

3883 CONTROL DEVICE FOR THE DISCHARGE STATE OF A BATTERY. Albert, W. (to Elektron Fabrik fuer Physikalisch Technische Geraete Kerber und Co.). GE 2,321,108. 21 Nov 1974. Filed date 26 Apr 1973. 12p.
ELECTRIC BATTERIES;CONTROL SYSTEMS;ELECTRIC POTENTIAL

3884 METAL CASES FOR ALKALINE BATTERIES. Tsuchida, T.; Shinoda, K.; Tamamoto, K. (to Fuji Electrochemical Co., Ltd.). GE 2,317,820. 21 Nov 1974. Filed date 9 Apr 1973. 12p.
ELECTRIC BATTERIES;CONTAINERS;IRON;ZINC

3885 SOLID SULFATE ELECTROLYTE FOR BATTERIES. Lunden, A.; Heed, B.; Kvist, A. German(FRG) Patent 2,422,007. 21 Nov 1974. Filed date 3 May 1973. 23p.
Patent; Ag/Li, Na, Ag, Mg, Zn, or Ca sulfate/ I. SILVER;SULFATES;GRAPHITE;IODINE;METAL-NONMETAL BATTERIES;ELECTRIC-POWERED VEHICLES; ELECTROLYTES;SOLIDS

3886 IRON ELECTRODE PASTE FOR ALKALINE BATTERY PLATES. Seidel, J. (to Westinghouse Electric Corp.). US Patent 3,849,198. 19 Nov 1974. Filed date 31 Jul 1973. 8p.
IRON-NICKEL BATTERIES;ANODES;IRON;ELECTRODES; PLATES;IRON OXIDES;PRODUCTION;ELECTRIC BATTERIES

3887 EXTRUDING AN ELECTRODE AND A CELL HAVING AN ELECTRODE MADE THEREBY. Malloy, J.P.; Nilson, R.R. (to ESB Inc.). Canadian Patent 958,071. 19 Nov 1974. Filed date 21 Jul 1970. 14p.
LEAD;ANODES;EXTRUSION;FABRICATION;LEAD-ACID BATTERIES

3888 ELECTROCHEMICAL GENERATOR WITH A ZINC ELECTRODE. Feuillade, G.; Cord, P. (to Compagnie Generale d'Electricite, Paris, France). US Patent 3,849,199. 19 Nov 1974. Filed date 16 Feb 1973. 4p.
SILVER-ZINC BATTERIES;NICKEL-ZINC BATTERIES; ZINC-MANGANESE BATTERIES;ANODES;ELECTRIC BATTERIES;ZINC;SODIUM PHOSPHATES;ELECTROLYTES; OXIDES

3889 METHOD FOR PRODUCING BATTERY TERMINAL. Hollis, N.E.; Jutte, G.W.; McCartney, F.I.; McHugh, J.V. (to Richardson Co., Des Plaines, IL). US Patent 3,849,203. 19 Nov 1974. Filed date 31 Aug 1973. 4p.
Patent; side wall terminals. ELECTRODES;LEAD-ACID BATTERIES;DESIGN;FABRICATION;AUTOMOBILES

3890 ALKALINE BATTERY. Nakajima, A.; Watabe, S. (to National Mallory Battery Corp.). Japanese Patent 41,607. 19 Nov 1974. Filed date 28 Dec 1968. 3p.
ELECTRIC BATTERIES;HYDROXIDES;ELECTROLYTES; BATTERY SEPARATORS;PAPER;PVA;BINDERS;CELLULOSE ESTERS;SURFACTANTS;AQUEOUS SOLUTIONS; FABRICATION;MASS TRANSFER

3891 CELL ELEMENT FOR ELECTRICAL STORAGE

BATTERIES. Marti Desclaux, V.E. Spanish Patent 394,268. 16 Nov 1974. Filed date 17 Aug 1971. 7p.
Patent; $PbO_2$/Zn. METAL-NONMETAL BATTERIES; LEAD OXIDES;ZINC;BATTERY CHARGING;ELECTRODES; DESIGN

3892 WATER-ABSORBING POROUS MATERIALS FOR BATTERY-ELECTROLYTE SUPPORT. Fujimoto, T.; Hayashi, S. (to Yuasa Battery Co., Ltd.). Japanese Patent 119,963. 15 Nov 1974. Filed date 20 Mar 1973. 3p.
ELECTROLYTES;SUPPORTS;RESINS;SILICON OXIDES; CHEMICAL PREPARATION;FILTERS;PHENOLS;GELS; ELECTRIC BATTERIES

3893 SUSPENSION CONTAINING CARBONYL NICKEL, BINDER, AND A SOLVENT FOR A POWDER-METALLURGICAL BASE OF AN ALKALINE BATTERY NONLAMELLAR ELECTRODE. Gvelesiani, D.F.; Lezhava, T.I.; Gugunishvili, G.G.; Takaishvili, O.G.; Mdinaradze, A.G.; Zambakhidze, R.T.; Kokhreidze, R.K.; Agniashvili, L.D. USSR Patent 450,262. 15 Nov 1974. Filed date 14 Feb 1972.
ELECTRIC BATTERIES;ELECTRODES;NICKEL NITRATES;BINDERS;SUSPENSIONS;POWDER METALLURGY; HYDROXIDES;CARBONYLS;NICKEL COMPLEXES; FABRICATION

3894 AERATION STOPPER FOR SECONDARY BATTERIES. Hennen, R.E. (to Globe-Union, Inc.). GE 2,402,718. 14 Nov 1974. Filed date 26 Apr 1973. 15p.
ELECTRIC BATTERIES;CLOSURES;VENTS

3895 INSULATING SEAL FOR MOLTEN SALT BATTERY. Sharma, R.S. (to General Motors Corp.). US Patent 3,847,675. 12 Nov 1974. Filed date 28 Nov 1972. 5p.
LITHIUM-SULFUR BATTERIES;SODIUM-SULFUR BATTERIES;ELECTRIC BATTERIES;SEALS;DIELECTRIC MATERIALS;LITHIUM FLUORIDES;HIGH TEMPERATURE; ELECTROLYTES;MOLTEN SALTS

3896 IN-SITU PREPARATION OF ELECTRODES FOR BATTERIES. Lambert, C.; Bono, P.; Pichon, B. (to Societe Generale de Constructions Electriques et Mecaniques(Alsthom)). French Patent 2,225,849. 08 Nov 1974. Filed date 16 Apr 1973. 6p.
ELECTRIC BATTERIES;ELECTRODES;IN-SITU PROCESSING;CHEMICAL PREPARATION

3897 STOPPER FOR SECONDARY BATTERIES. Schmidt, H. GE 2,321,930. 7 Nov 1974. Filed date 30 Apr 1973. 5p.
Floating needle for external electrolyte level control. ELECTRIC BATTERIES;CLOSURES; ELECTROLYTES;LEVELS

3898 INCREASING THE ENERGY STORAGE CAPACITY OF AN ELECTRODE OF AMORPHOUS CARBON. Metcalfe, J.E., III; Rightmire, R.A.; Marse, A.V. (to Standard Oil Co. (Ohio)). German(FRG) Patent 2,320,413. 7 Nov 1974. Filed date 21 Apr 1973. 19p.
ENERGY STORAGE;CATHODES;CARBON;SULFUR; HALIDES;OXYCHLORIDES;LITHIUM-SULFUR BATTERIES; ELECTRIC BATTERIES

3899 EXPANDER FOR LEAD BATTERY ANODE. Yampol'skaya, E.G.; Smirnova, I.A.; Moiseeva, V.I.; Zinchenko, Yu.A.; Sapotnitskii, S.A.; Belodubrovskii, R.B.; Alekseeva, N.G.; Kryukova, L.I. USSR Patent 449,401. 5 Nov 1974. Filed date 1 Jun 1973.
LEAD-ACID BATTERIES;ANODES;RESINS;ADDITIVES; ORGANIC COMPOUNDS;BARIUM SULFATES

3900 LEAD BATTERY ELECTRODES. Zinchenko, Yu.A.; Tyutina, L.S.; Chaivanova, A.G.; Kucher, D.A.; Denisova, A.A.; Bogachek, G.G.; Stepanov, V.I.; Laevskii, D.I.; Yampol'skaya, E.G. USSR Patent 449,402. 5 Nov 1974. Filed date 1 Jun 1973.
LEAD-ACID BATTERIES;ELECTRODES;FABRICATION; DRYING;IMPREGNATION;BORIC ACID

3901 ELECTROCHEMICAL CONTACT. (to Gates Rubber Co.). Belgian Patent 817,275. 4 Nov 1974. Filed date 14 Nov 1972. 23p.
Patent; between pole and electrolyte. ELECTRIC BATTERIES;ELECTRIC CONTACTS;ELECTRODES; ELECTROLYTES;FASTENERS;LEAD;LEAD ALLOYS;TIN ALLOYS;CALCIUM ALLOYS;ANTIMONY ALLOYS

3902 NICKEL ELECTRODES FOR ALKALI BATTERIES. Kanada, Y. (to Ray-O-Vac Co., (Japan) Ltd.). Japanese Patent 114,748. 1 Nov 1974. Filed date 9 Mar 1973. 3p.
Patent; preparation. NICKEL-CADMIUM BATTERIES;NICKEL-ZINC BATTERIES;IRON-NICKEL BATTERIES;ELECTRIC BATTERIES;CATHODES;NICKEL; NICKEL COMPOUNDS;HYDROXIDES;CHEMICAL PREPARATION;NICKEL OXIDES;NICKEL SULFATES; SODIUM COMPOUNDS;HYPOCHLOROUS ACID;POTASSIUM HYDROXIDES;GRAPHITE;POLYSTYRENE

3903 ELECTROCHEMICAL BEHAVIOR OF IRON IN ALKALINE SULPHATE SOLUTIONS. Geana, D.; El Miligy, A.A.; Lorenz, W.J. (Univ., Karlsruhe, Ger.). J. Appl. Electrochem.; 4: No. 4, 337-345(Nov 1974).
MEDIUM TEMPERATURE;METAL-GAS BATTERIES;IRON; AIR;IRON-NICKEL BATTERIES;ELECTRODES; ELECTROCHEMISTRY

3904 EVALUATION OF EXPANDERS USED IN THE NEGATIVE LEAD BATTERY ELECTRODE. Azim, A.A.; Ismail, A.A. (National Research Center, Cairo). J. Appl. Electrochem.; 4: No. 4, 351-356(Nov 1974).
LEAD-ACID BATTERIES;ANODES;ALKYNES;BARIUM SULFATES;HUMIC ACIDS;LIGNIN;HYDROGEN; PERFORMANCE

3905 CORROSION OF PURE AND AMALGAMATED ZINC IN CONCENTRATED ALKALI HYDROXIDE SOLUTIONS. Vorkapic, L.Z.; Drazic, D.M.; Despic, A.R. (Inst. of Chemistry, Technology, and Metallurgy, Belgrade). J. Electrochem. Soc.; 121: No. 11, 1385-1392(Nov 1974).
The problem of corrosion of zinc in alkaline solutions has become a topic of considerable interest with the increasing use of zinc as the anode in a variety of alkaline batteries (primary alkaline zinc battery, secondary silver--zinc, and both primary and secondary zinc--air batteries), some of which contain great promise for propulsion of electric vehicles. Corrosion of pure and amalgamated zinc in pure concentrated KOH solutions was investigated using two methods: galvanostatic measurements of the kinetics of hydrogen evolution with electrodic assessment of corrosion properties of the system and volumetric measurement of the hydrogen evolution reflecting directly the rate of corrosion. The latter was followed as a function of time during 150 h. It was found that the corrosion rate varies considerably with time, and it was suggested that different factors control the initial and the steady-

state corrosion. The initial corrosion rate increases with increasing KOH concentration; this behavior is indicative of the chemical mechanism of hydrogen evolution. The change of the corrosion rate with time and the steady-state corrosion rate can be explained in terms of formation of an impermeable ZnO film at the surface.

3906 EFFECTS OF CALCIUM, TIN, AND BISMUTH ON THE EARLY STRENGTH OF CALCIUM--LEAD ALLOYS. Myers, M.; van Handle, H.R.; DiMartini, C.R. (American Smelting and Refining Co., South Plainfield, NJ). J. Electrochem. Soc.; 121: No. 11, 1526-1530(Nov 1974).
Over the last several years, interest in calcium--lead alloys for use as grids in SLI batteries has greatly increased due to the expected requirement for maintenance-free (low-gassing) batteries in the automotive industry. The effects of calcium content as well as additions of tin and bismuth on the mechanical properties of calcium--lead alloys were investigated. The alloys were wrought and heat-treated in order to avoid the problems raised by the presence of casting variables. The previously reported increase in the rate of hardening with increasing calcium content was confirmed. Binary alloys containing less than 0.04% calcium showed no strengthening 1 h after quench from the solution treatment temperature, while 0.1% calcium nearly doubled in tensile strength in only 5 min. Tin, in additions of 0.5 and 1%, completely restrained hardening in the first hour after quench in both 0.06 and 0.1% calcium alloy. Bismuth additions were made up to 1000 ppm. No effect was noted on the early strength of the 0.1% calcium alloys, but the rate of hardening of the 0.06% calcium alloys was significantly enhanced by the presence of bismuth. These findings show that early strength of calcium--lead alloys may be improved by limiting tin content, increasing calcium content, or adding bismuth to low-percentage calcium alloys.

3907 LEAD ALLOYS OF HIGH CREEP RUPTURE STRENGTH. Heuber, U. (to Metallgesellschaft AG). GE 2,319,711. 31 Oct 1974. Filed date 18 Apr 1973. 6p.
LEAD BASE ALLOYS;ANTIMONY ALLOYS;ARSENIC ADDITIONS;COPPER ADDITIONS;SILVER ADDITIONS;TIN ADDITIONS;SULFUR ADDITIONS;CREEP;RUPTURES; ELECTRIC BATTERIES;LEAD-ACID BATTERIES; ELECTRODES

3908 INTRODUCTION OF ACTIVE MATERIALS INTO POROUS ELECTRODE FRAMEWORKS FOR ALKALINE BATTERIES. Buder, E.; Knabenbauer, W. (to Varta Batterie AG). GE 2,318,075. 31 Oct 1974. Filed date 11 Apr 1973. 12p.
ELECTRIC BATTERIES;ELECTRODES;PRODUCTION; DIFFUSION

3909 GAS DIFFUSION ELECTRODE FOR BATTERIES. Vignaud, R. (to Societe les Piles Wonder). French Patent 2,224,881. 31 Oct 1974. Filed date 5 Apr 1973. 13p.
Mixture of conducting material (e.g. powdered metal) and hologenated material (e.g. teflon;patent. ELECTRIC BATTERIES;ELECTRODES; GASES;DIFFUSION;POLYETHYLENES;METALS;POWDERS; TEFLON;ACTIVATED CARBON;IRON;NICKEL;CHROMIUM; COBALT;SILVER;COPPER;MERCURY;PLATINUM;PALLADIUM; METAL-GAS BATTERIES

3910 ALKALINE BATTERY SEPARATOR. (to Fuji Electrochemical Co., Ltd.). French Patent 2,224,879. 31 Oct 1974. Filed date 6 Apr 1973. 9p.
BATTERY SEPARATORS;HYDROXIDES;POLYPROPYLENE; AQUEOUS SOLUTIONS;PERFORMANCE;FABRICATION; SURFACTANTS;POLYACETALS;AMINES

3911 METALLIC CASES FOR ALKALINE BATTERIES. (to Fuji Electrochemical Co., Ltd.). French Patent 2,224,878. 31 Oct 1974. Filed date 6 Apr 1973. 9p.
ELECTRIC BATTERIES;CONTAINERS;HYDROXIDES; IRON;ZINC;CHROMATES

3912 MOLDING AND HARDENING GRIDS FOR LEAD STORAGE BATTERY PLATES. (to Varta Batterie AG). French Patent 2,224,551. 31 Oct 1974. Filed date 4 Apr 1973. 5p.
LEAD-ACID BATTERIES;GRIDS;PLATES;MOLDING; HARDENING;LEAD ALLOYS;ANTIMONY ALLOYS

3913 LEAD BATTERY ALLOY. Ustimov, M.I.; Elyakov, I.I. (to Kalinin, M.I., Chimkent Lead Plant). USSR Patent 448,242. 30 Oct 1974. Filed date 3 May 1973.
LEAD-ACID BATTERIES;LEAD ALLOYS;ELECTRODES; CHEMICAL PREPARATION;ARSENATES;SODIUM COMPOUNDS; ZINC CHLORIDES;AMMONIUM COMPOUNDS;CHLORIDES; ANTIMONY COMPOUNDS;OXYGEN;ANODES

3914 SILVER ELECTRODE FOR BATTERY. Shteinberg, A.N.; Osipov, B.N.; Lev, M.B.; Knyazev, B.D.; Mendzheritskii, E.A.; Trofimov, A.V.; Makeichik, V.Ya. USSR Patent 448,514. 30 Oct 1974. Filed date 28 Dec 1972. 110p.
Patent; fabrication. ELECTRIC BATTERIES; ELECTRODES;SILVER-ZINC BATTERIES;SILVER-CADMIUM BATTERIES;FABRICATION;CATHODES

3915 ALKALINE CELLS WITH ANODES MADE FROM ZINC FIBERS AND NEEDLES. Louzas, D.V. (to Union Carbide Corp.). US Patent 3,844,838. 29 Oct 1974. Filed date 3 Apr 1970. 21p.
ZINC;ANODES;NICKEL-ZINC BATTERIES;SILVER-ZINC BATTERIES;FABRICATION;HYDROXIDES

3916 INSULATING SEAL FOR MOLTEN SALT BATTERY. Sharma, R.A.; Rhodes, J.F. (to General Motors Corp.). US Patent 3,844,842. 29 Oct 1974. Filed date 28 Nov 1972. 5p.
Patent; LiF + filler for high-temperature batteries, fabrication. MOLTEN SALTS;HIGH TEMPERATURE;ELECTRIC BATTERIES;DIELECTRIC MATERIALS;SEALS;LITHIUM FLUORIDES;FILLERS; ELECTROLYTES;GRAPHITE;CYLINDERS;YTTRIUM OXIDES; FABRICATION

3917 ALKALINE CELLS WITH ANODES MADE FROM ZINC FIBERS AND NEEDLES. Louzos, D.V. (to Union Carbide Corp., New York, NY). US Patent 3,844,838. 29 Oct 1974. Filed date 13 Mar 1972. 22p.
Patent; process for preparing fibers and needles. ELECTRIC BATTERIES;HYDROXIDES;NICKEL-ZINC BATTERIES;SILVER-ZINC BATTERIES;ZINC-MANGANESE BATTERIES;ANODES;FIBERS;CHEMICAL PREPARATION;MOLDING

3918 EVALUATION OF THE CORROSION RATE OF LEAD AND ITS ALLOYS USED FOR STORAGE BATTERIES. Kukoz, F.I.; Sapozhnikov, A.V. UR 447,780. 25 Oct 1974. Filed date 26 Jan 1973.
LEAD;LEAD ALLOYS;CORROSION;SULFURIC ACID; ALTERNATING CURRENT;POLARIZATION;LEAD-ACID BATTERIES;ELECTRODES;ANODES

3919 MICROPOROUS SEPARATOR FOR BATTERY.

Druzhinin, E.A. USSR Patent 447,779. 25 Oct 1974. Filed date 26 Jan 1973.
BATTERY SEPARATORS;FABRICATION;POROSITY; SURFACTANTS;PRESSING;MEDIUM TEMPERATURE; CHLORINATED ALIPHATIC HYDROCARBONS

3920 SOLID ELECTROLYTE COMPOSITION FOR SECONDARY BATTERY. Ikeda, H.; Narukawa, S.; Kawai, Y. (to Sanyo Electric Co., Ltd.). Japanese Patent 74,112,195. 25 Oct 1974. Filed date 28 Feb 1973. 3p.
NaI--$(CH_2)_6N_4CH_3I$ for Na batteries; patent. ELECTRIC BATTERIES;ELECTROLYTES;SOLIDS;SODIUM IODIDES;ORGANIC NITROGEN COMPOUNDS;IODINATED ALIPHATIC HYDROCARBONS

3921 ELECTRICAL CONDUCTOR FOR LEAD STORAGE BATTERIES. Sundberg, E.G.; Quist, K.; Wingbro, T. (to Aktiebolag Tudor). German(FRG) Patent 2,415,032. 24 Oct 1974. Filed date 3 Apr 1973. 14p.
LEAD-ACID BATTERIES;LEAD;COPPER;ALUMINIUM; ALUMINIUM ALLOYS;COPPER ALLOYS;LEAD ALLOYS; ELECTRIC CONDUCTORS;CONDUCTOR DEVICES;EXTRUSION

3922 APPARATUS FOR DETERMINING THE DENSITY OF ELECTROLYTE IN LEAD STORAGE BATTERIES. Schmechtig, R. (to Aktiebolag Tudor). German(FRG) Patent 2,415,033. 24 Oct 1974. Filed date 3 Apr 1973. 16p.
LEAD-ACID BATTERIES;ELECTROLYTES;DENSITY; DENSIMETERS;PIPES;LEAKS;DESIGN

3923 LEAD DIOXIDE CELL. Matsuno, S.; Kobayashi, S. (to Yuasa Battery Co., Ltd.). Japanese Patent 74 39,328. 24 Oct 1974. Filed date 8 Dec 1967. 3p.
Patent; $PbO_2$/Al or Mg. ELECTRIC BATTERIES; LEAD OXIDES;ALUMINIUM;MAGNESIUM;SEAWATER; ELECTROLYTES;CATHODES;ELECTRIC CONDUCTIVITY

3924 APPARATUS AND METHOD FOR MAINTAINING BATTERIES AT OPERATIONAL TEMPERATURE. Terasaki, M. (to Japan Storage Battery Co., Ltd.). Japanese Patent 111,129. 23 Oct 1974. Filed date 26 Feb 1973. 3p.
HEATING;SODIUM-SULFUR BATTERIES;ELECTRIC BATTERIES;SODIUM HYDROXIDES;SODIUM NITRATES; ZINC CHLORIDES

3925 ELECTRODE FOR SECONDARY STORAGE BATTERY. Langer, A.; Patton, J.T. (to Westinghouse Electric Corp.). Canadian Patent 956,698. 22 Oct 1974. Filed date 02 Oct 1969. 18p.
Ni fibers with iron oxide as active agent, additives; patent. IRON-NICKEL BATTERIES;ANODES; ELECTRIC BATTERIES;ELECTRODES;NICKEL;IRON OXIDES;SULFUR;SELENIUM;TELLURIUM;ALKALI METALS; IRON COMPOUNDS;PERFORMANCE

3926 CATHODES FOR ALKALINE BATTERIES. Yasuda, H. (to Japan Storage Battery Co., Ltd.). Japanese Patent 74,109,842. 18 Oct 1974. Filed date 22 Feb 1973. 3p.
ELECTRIC BATTERIES;HYDROXIDES;CATHODES; CHEMICAL PREPARATION;ALUMINIUM;ALUMINIUM COMPOUNDS;NICKEL HYDROXIDES;SINTERED MATERIALS; PERFORMANCE;NICKEL;SUBSTRATES;NICKEL NITRATES; IMPREGNATION;NICKEL-CADMIUM BATTERIES;NICKEL-ZINC BATTERIES;IRON-NICKEL BATTERIES

3927 PLATE GRID FOR LEAD STORAGE BATTERIES. Brinkmann, J.; Trippe, G.; Heissman, W. (to Varta Batterie Aktiengesellschaft). US Patent 3,959,015. 18 Oct 1974. Priority date 21 Dec 1973, German, Federal Republic of (F.R. Germany). vp.
A grid plate for a lead storage battery includes generally parallel, vertically extending grid rods and a current take-off connector positioned adjacent the upper ends of the rods. At least some of the rods have the portions farthest from the take-off connector formed as half rods and the portions closest to the connector as whole rods. Another embodiment has at least some of the rods formed partly as half rods located on only one side of a plane parallel to the grid surface and partly as whole rods located on both sides of the plane.

3928 GAS VENT FOR LEAD BATTERIES. McDowall, W.L. (to Dunlop Australia Ltd.). German(FRG) Patent 2,413,638. 17 Oct 1974. Filed date 22 Mar 1973. 12p.
LEAD-ACID BATTERIES;VENTS;TEFLON;DESIGN

3929 MANGANESE DIOXIDE. Shiramoto, T. (to Matsushita Electric Industrial Co., Ltd.). Japanese Patent 74 109,297. 17 Oct 1974. Filed date 20 Feb 1973. 2p.
Patent; chemical preparation. MANGANESE OXIDES;ZINC-MANGANESE BATTERIES;ANODES;CHEMICAL PREPARATION

3930 COMPACTING OF ACTIVE MATERIAL FOR BATTERIES. Wiepen, R. (to Varta Batterie AG). German(FRG) Patent 2,315,984. 17 Oct 1974. Filed date 30 Mar 1973. 8p.
LEAD-ACID BATTERIES;PLATES;TUBES;LEAD OXIDES; FABRICATION;COMPACTING;COMPRESSION

3931 RECLAIMING ELECTROLYTE FOR REUSE IN BATTERIES. Marchetti, R.A. US Patent 3,841,916. 15 Oct 1974. Filed date 5 Sep 1972. 3p.
LEAD-ACID BATTERIES;ELECTROLYTES;RECOVERY

3932 LEAD ALLOY FOR GRIDS OF LEAD--ACID BATTERIES. Barnes, S.C.; Lawrie, R.J. (to Lucas, Joseph, (Batteries) Ltd.). GE 2,414,976. 10 Oct 1974. Filed date 7 Apr 1973. 8p.
Casting. LEAD-ACID BATTERIES;GRIDS;HIGH TEMPERATURE;CASTING;LEAD BASE ALLOYS;CALCIUM ADDITIONS;LITHIUM ADDITIONS;ALUMINIUM ADDITIONS

3933 COMPOSITE POROUS ELECTRODE. Yao, N-P; Oliver, R.L.; Seiger, H.N. (to Textron, Inc.). US Patent 3,840,407. 08 Oct 1974. Filed date 19 Jun 1972. 10p.
ELECTRIC BATTERIES;POROSITY;ELECTRODES;GASES; DIFFUSION;METAL-GAS BATTERIES;FABRICATION

3934 RECHARGEABLE CELL HAVING CERAMIC--METAL TERMINAL SEAL RESISTANT TO ALKALI ELECTROLYTE. Bondley, R.J. (to General Electric Co.). US Patent 3,840,408. 8 Oct 1974. Filed date 20 Sep 1971. 6p.
ELECTRIC BATTERIES;ELECTRODES;NICKEL; CERAMICS;HYDROXIDES;ELECTROLYTES;ALUMINIUM OXIDES;BONDING;NICKEL-CADMIUM BATTERIES;NICKEL-ZINC BATTERIES;IRON-NICKEL BATTERIES

3935 SEPARATOR FOR ALKALINE CELLS. Takasawa, N.; Matsuki, Y. (to Furukawa Battery Co., Ltd.). Japanese Patent 74 105,934. 7 Oct 1974. Filed date 16 Feb 1973. 2p.
Patent; preparation. BATTERY SEPARATORS;PVA; SILVER-CADMIUM BATTERIES;PERFORMANCE; FABRICATION;CHEMICAL PREPARATION

3936 WETTABLE BATTERY SEPARATOR AND PROCESS THEREFOR. Wszolek, W.R.; Cogliana, J.A. (to W. R. Grace and Co.). US Patent 3,951,691. 7 Oct 1974. vp.
A process for imparting permanent wettability to a battery separator comprising a non-woven mat of polyolefin fiber is described. The process comprises impregnating the mat with 0.2 to 30 percent by weight of an α-olefin/α,β-unsaturated acid or anhydride copolymer, the copolymer containing about 5 to about 80 weight percent α,β-unsaturated acid or anhydride and being dissolved in an amount ranging from 0.5 percent to 33 percent by weight in an aqueous base and thereafter regenerating the copolymer to a water-insoluble, substantially free acid form by volatilization or neutralization of the base.

3937 BATTERY CASING. Thornton, R.F. (to General Electric Co.). US Patent 3,959,011. 4 Oct 1974. vp.
A battery casing comprises an inner casing of a solid sodium ion-conductive material with one open end and an outer metallic casing with an upper portion and a lower portion. The upper portion has opposite open ends, with an inwardly extending flange affixed to the upper portion at its first open end. The lower portion has opposite open ends, a removable closure for its first open end, and an opening in the removable closed ends. The upper and lower portions are joined together at their associated second open ends. A metallic closure consists of a cap portion with a flange and a cap insert. The flange of the cap portion is positioned adjacent the flange of the upper portion of the outer metallic casing. A first glass seal seals together the adjacent flanges of the upper portion of the outer metallic casing and of the cap portion of the metallic closure, and seals the adjacent flanges to the outer wall of the inner casing adjacent its open end. A second glass seal seals together the opposite surface of the flange of the upper portion of the outer metallic casing and a portion of the outer wall of the inner casing. The cap insert is adapted to be positioned within the cap portion, thereby closing the open end of the inner casing.

3938 STORAGE BATTERY PLATE. Morelock, C.R.; Lord, P.C.; Weininger, J.L. (to General Electric Co.). US Patent 3,839,090. 1 Oct 1974. Filed date 20 Aug 1973. 5p.
LEAD-ACID BATTERIES;PLATES;GRIDS;WIRES;LEAD; LEAD ALLOYS;CARBON;FIBERS;FABRICATION

3939 ELECTROINITIATED POLYMERIZATION OF TETRAHYDROFURAN. Dey, A.N.; Rudd, E.J. (P.R. Mallory and Co., Burlington, MA). J. Electrochem. Soc.; 121: No. 10, 1294-8(Oct 1974).
ELECTRIC BATTERIES;ELECTROLYTES;FURANS; POLYMERIZATION;ELECTROCHEMISTRY;MEDIUM TEMPERATURE

3940 MANGANESE DIOXIDE ELECTRODE AT POTENTIALS AT AND CLOSE TO THE OPEN CIRCUIT POTENTIAL OF THE ELECTRODE. Valand, T. (Norwegian Defence Research Establishment, Kjeller). Electrochim. Acta; 19: No. 10, 639-643(Oct 1974).
A thermodynamic treatment of the proton equilibrium shows that the electrode potential of the manganese dioxide electrode referred to the hydrogen electrode in the same solution should be pH independent. As this is not confirmed by the literature values of the electrode potential, a study of the electrode near the open circuit potential was performed. The results were treated by using a spherical model for diffusion in the electrode. 5 figures.

3941 BATTERY AND BATTERY SEPARATOR. Megahed, E.S.; Peters, R.W. (to ESB Inc). German(FRG) Patent 2,413,954. 26 Sep 1974. Filed date 23 Mar 1973. 57p.
Patent; organic compounds. POTASSIUM HYDROXIDES;HYDROXIDES;BATTERY SEPARATORS; BINDERS;ZINC OXIDES;CELLULOSE ESTERS;CELLULOSE; CELLOPHANE;INORGANIC COMPOUNDS;FABRICATION

3942 SILVER ELECTRODES FOR CHEMICAL SOURCES OF ELECTRIC POWER. Terent'ev, N.K.; Seliverstov, S.D.; Fishman, B.I.; Nikol'skii, V.A.; Malyarov, Yu.G. USSR Patent 444,281. 25 Sep 1974. Filed date 19 Mar 1973.
FABRICATION;SILVER;ELECTRODES;ELECTRIC BATTERIES;SILVER-ZINC BATTERIES;SILVER-CADMIUM BATTERIES;CATHODES

3943 PREPARATION OF CADMIUM ELECTRODES. Gutrdige, I.P. (to International Nickel Co., Inc., New York, NY). US Patent 3,837,919. 24 Sep 1974. Filed date 20 Oct 1972. 4p.
NICKEL-CADMIUM BATTERIES;ANODES;CADMIUM HYDROXIDES;ELECTRODEPOSITION;CADMIUM NITRATES; NICKEL NITRATES

3944 ELECTROCHEMICAL GENERATORS. Cailley, J.-P.; Braun, H. (to Saft-Societe des Accumulateurs Fixes et de Traction, Romainville, France). US Patent 3,837,925. 24 Sep 1974. Filed date 25 Sep 1972. 6p.
Patent; description of electrode assembly. ELECTRIC BATTERIES;DESIGN;ELECTRODES;CONNECTORS

3945 ELECTRODE FOR LEAD STORAGE BATTERY. Ziegler, S.; Seiboth, W. (to Bosch, Robert, GmbH). GE 2,310,402. 19 Sep 1974. Filed date 2 Mar 1973. 6p.
LEAD-ACID BATTERIES;ELECTRODES;FABRICATION; ALUMINIUM

3946 LEAD ALLOYS FOR STORAGE-BATTERY PLATES. Peters, K. (to Electric Power Storage Ltd.). GE 2,412,320. 19 Sep 1974. Filed date 15 Mar 1973. 14p.
LEAD-ACID BATTERIES;PLATES;LEAD BASE ALLOYS; BRINELL HARDNESS;BENDING;ANTIMONY ALLOYS; ARSENIC ADDITIONS;COPPER;TIN;TELLURIUM;SULFUR

3947 APPARATUS FOR INDICATING DENSITY THRESHOLD VALUE AND ITS USE WITH STORAGE BATTERIES. Piessis, R. (to Societe Fulmen; Compagnie Europeene d'Accumulateurs). German(FRG) Patent 2,409,960. 19 Sep 1974. Filed date 12 Mar 1973. 10p.
ELECTRIC BATTERIES;ELECTROLYTES;DENSITY; MEASURING INSTRUMENTS;TUBES;LEVELS;LIQUIDS;LEAD-ACID BATTERIES

3948 ELECTRODES, ESPECIALLY CONTROL AND GAS-CONSUMING ELECTRODES FOR LEAD STORAGE BATTERIES. Jung, M. (to Varta Batterie AG). German(FRG) Patent 2,312,131. 19 Sep 1974. Filed date 12 Mar 1973. 18p.
Patent; graphite, teflon, WC. ELECTRODES; LEAD-ACID BATTERIES;GRAPHITE;TEFLON;TUNGSTEN CARBIDES

3949 ACTIVE IRON MASS FOR ELECTRODES.

Oliapuram, A. (to Varta Batterie AG). German(FRG) Patent 2,312,132. 19 Sep 1974. Filed date 12 Mar 1973. 7p.
Patent; fabrication. IRON-NICKEL BATTERIES; ANODES;FABRICATION;HYDROXIDES;CHEMICAL PREPARATION;MEDIUM TEMPERATURE

3950 UNSATURATED POLYESTER RESIN COMPOSITIONS. Shigaki, Y. (to Moon Star Chemical Corp.). Japanese Patent 98,891. 18 Sep 1974. Filed date 12 Jan 1973. 3p.
ELECTRIC BATTERIES;CONTAINERS;FABRICATION; EPOXIDES;POLYESTERS;RESINS;CHEMICAL PREPARATION

3951 NICKEL FLUORIDE. Saldick, J. (to FMC Corp.). US Patent 3,836,634. 17 Sep 1974. Filed date 10 Feb 1969. 2p.
Patent; Li/$NiF_2$ cathode preparion. METAL-NONMETAL BATTERIES;LITHIUM;NICKEL FLUORIDES; CATHODES;CHEMICAL PREPARATION

3952 LAMINATED DIFFUSION BONDED BATTERY PLAQUES. Pollack, W. (to Westinghouse Electric Corp.). US Patent 3,835,514. 17 Sep 1974. Filed date 17 May 1971. 9p.
Patent; preparation. NICKEL-CADMIUM BATTERIES;IRON-NICKEL BATTERIES;FABRICATION; LAMELLAE;CATHODES;BONDING;MEDIUM PRESSURE;HIGH PRESSURE

3953 PRODUCTION OF NICKEL FLUORIDE. Saldick, J. (to FMC Corp., New York, NY). US Patent 3,836,634. 17 Sep 1974. Filed date 10 Feb 1969. 4p.
Patent; for lithium--nickel fluoride batteries. NICKEL FLUORIDES;METAL-NONMETAL BATTERIES;CATHODES;LITHIUM;CHEMICAL PREPARATION; HIGH TEMPERATURE

3954 EXPLOSION-PROOF VENTING DEVICE FOR ELECTRICAL STORAGE BATTERIES. Auerbach, J. US Patent 3,944,437. 16 Sep 1974. vp.
An explosion-proof venting device for storage batteries comprises a cup-shaped body having a substantially tubular lower end for connection with a cell aperture of the storage battery; a centrally pierced horizontal plate connected to the cup-shaped body near the top thereof; a ring-shaped disc of acid-resistant porous material, serving as a flame barrier, attached to the underside of the horizontal plate; a lid carried on the top end of the cup-shaped body and spaced from the horizontal plate, the space between the lid and the plate having access to the atmosphere; and directing means for forcing gas entering the tubular lower end of the cup-shaped body to pass through the disc and the plate before passing to the atmosphere.

3955 LOW PRESSURE NICKEL HYDROGEN CELL. Dunlop, J.D.; Earl, M.W.; Van Ommering, G. (to Communications Satellite Corp.). US Patent 3,959,018. 16 Sep 1974. Filed date 27 Nov 1972. vp.
An improved rechargeable power cell comprises a sealed container which includes a first electrode means comprising an oxidizing agent, a second electrode means comprising a catalyst mounted on a conductive support (the catalyst being a material capable of dissociating molecular hydrogen to monatomic hydrogen), an alkaline electrolyte, electrolyte retaining means disposed between the first and second electrode means, and a supply of hydrogen in the container. The improvement comprises a hexagonal rare earth intermetallic hydride disposed within the container out of contact with the electrolyte. The intermetallic hydride is a material capable of absorbing and desorbing hydrogen in response to changes in pressure.

3956 SAFETY DEVICE AGAINST OVERCHARGING FOR MAINENANCE-FREE STORAGE BATTERIES. Eisenacher, W.; Blaich, E. (to Bosch, Robert, GmbH). GE 2,310,403. 12 Sep 1974. Filed date 2 Mar 1973. 9p.
BATTERY CHARGING;LEAD-ACID BATTERIES;GASES; PRESSURE DEPENDENCE

3957 LEAD STORAGE BATTERY. Kondo, K.; Ito, T.; Ohtomo, K. (to Kanebo Co., Ltd.). German(FRG) Patent 2,406,412. 12 Sep 1974. Filed date 14 Feb 1973. 41p.
Patent; acid- and oxidation-resistant separator with improved performance. LEAD-ACID BATTERIES;BATTERY SEPARATORS;DESIGN

3958 TUBULAR ELECTRODE PLATES FOR LEAD STORAGE BATTERIES. Sucher, J.; Steffens, K. (to Varta Batterie AG). German(FRG) Patent 2,311,082. 12 Sep 1974. Filed date 6 Mar 1973. 8p.
TUBES;PLATES;ELECTRODES;LEAD-ACID BATTERIES; SEALS;POLYPROPYLENE;POLYETHYLENES;FABRICATION

3959 TUBULAR ELECTRODE PLATES FOR LEAD STORAGE BATTERIES. Luedicke, W. (to Varta Batterie AG). German(FRG) Patent 2,311,051. 12 Sep 1974. Filed date 6 Mar 1973. 8p.
LEAD-ACID BATTERIES;ELECTRODES;PLATES;TUBES; FABRICATION;LEAD

3960 HOUSING FOR BATTERY CELL WITH PROTECTION FOR PRESSURE AND TEMPERATURE. Rackin, M.H. (to Motorola, Inc.). US Patent 3,933,526. 9 Sep 1974. vp.
A housing for a rechargeable battery cell having two-electrodes, includes the following: a tubular member having two ends; a closure for the first end having a first conducting contact connected to a first electrode of the battery; a conducting inner closure for the second end connected to the second electrode of the battery; and a conducting outer closure for the second end having a second conducting contact. The outer closure is movable from a first normal position, in which the outer closure makes electrical connection with the inner closure, to a second position, in which the outer closure is spaced apart from the inner closure. T his outer closure is responsive to a rise in temperature in the battery cell, and moves to the second position to open the circuit from the first and second conducting contacts to the electrodes of the battery.

3961 SECONDARY ELECTROCHEMICAL CELLS WITH A CHALOGEN CATHODE. Rubischko, R.J.; Cairns, E.J.; Steunenberg, R.K. (to US AEC). US Patent 3,833,421. 3 Sep 1974. Filed date 27 Dec 1972. 8p.
Li/S or similar materials; patent. METAL-NONMETAL BATTERIES;CATHODES;FABRICATION;ALKALI METALS;ELECTRIC-POWERED VEHICLES;SULFUR; SELENIUM;LITHIUM;SODIUM

3962 BATTERY CHARGE CONDITION MONITORING. Christianson, C.C. SAE Prepr.; No. 740728, vp.(Sep 1974).
Basic techniques are presented for determining the charge condition of electric-vehicle propulsion batteries of both the lead--acid and nickel--cadmium types. The techniques

presented include those employing measurement of battery parameters, such as electrolyte properties, voltage, and internal resistance, and those utilizing coulometric measurements. An application example employing the coulometric approach is described to demonstrate the usefulness of an accurate battery charge condition signal in an automated material handling car system.

3963 DEVELOPMENT OF LOW ANTIMONY LEAD ALLOYS FOR STARTER BATTERY GRIDS. Borchers, H.; Nijhawan, S.C.; Scharfenberger, W. (Technische Univ., Munich). Metall; 28: No. 9, 863-867(Sep 1974). (In German).
The applicability in starter grids of lead alloys containing 3.5 to 1.6% Sb rather than 5 to 8% was investigated. It was found that decreasing Sb decreases mechanical strength. However, more than sufficient strength can be restored by simple age hardening, i.e., by faster cooling after solidification, or solution annealing and quenching, and by arsenic addition. Increasing tendency for coarse-grain formation with decrease in Sb content, solidification cracks, and other casting defects which decrease the ductility of the starter grids can be eliminated by selenium grain-refining additions. Additions of tin improve mold-filling capacity. Micrographs and plotted properties are given.

3964 LEAD STORAGE BATTERY. Ito, T.; Ohtomo, K. (to Kanebo Kabushiki Kaisha). US Patent 3,953,236. 30 Aug 1974. Priority date 5 Sep 1973, Japan. vp.
A paste-type lead storage battery is composed of unit cells. Each is constructed in laminated form and includes a positive plate coated on both surfaces with an active material, a fibrous structure placed on each side of the positive plate, and a negative plate placed on each fibrous structure. The improvement comprises a separator interposed between the fibrous structure and the negative plate on both sides of the positive plate. The separator consists of a paper-like sheet having continuous microporous openings throughout its entire area and containing at least 70 percent by weight of phenol resin fibers, each having a diameter of 5 microns or less and produced by melt-spinning and curing a novolak resin. The phenol resin fibers have at least 60 percent by mole of the phenolic hydroxyl groups of the resin capped to esterify or etherify the phenolic hydroxyl groups.

3965 POROUS NICKEL PLATES FOR ELECTRODES. Hancock, H.; Evans, D.J. (to Sherritt Gordon Mines Ltd.). GE 2,407,030. 29 Aug 1974. Filed date 22 Feb 1973. 16p.
Method for fabrication. NICKEL-CADMIUM BATTERIES;NICKEL-ZINC BATTERIES;NICKEL-HYDROGEN BATTERIES;IRON-NICKEL BATTERIES;NICKEL; FABRICATION;CATHODES;ELECTRIC BATTERIES

3966 SEPARATORS FOR ALKALINE BATTERIES. (to Gates Rubber Co.). British Patent 1,365,313. 29 Aug 1974. Filed date 3 Aug 1970. 6p.
Patent; 180 cycles, mid-life voltage = 1.55 V. BATTERY SEPARATORS;HYDROXIDES;DESIGN;GELS; NICKEL-ZINC BATTERIES;PERFORMANCE;LIFETIME

3967 CATHODES FOR LEAD--ACID BATTERIES. (to Accumulatoren-Fabrik Oerlikon). German(FRG) Patent 2,409,172. 29 Aug 1974. Filed date 28 Feb 1973. 9p.
Patent; fabrication. LEAD-ACID BATTERIES; CATHODES;FABRICATION;LEAD;DUSTS;CELLULOSE ESTERS;WATER

3968 MIXTURE FOR MAKING POROUS ELECTRODES. Gugunishvili, G.G.; Takaishvili, O.G.; Lezhava, T.I.; Gvelesiani, D.F.; Motsonelidze, E.P.; Karachentseva, Yu.M.; Mdinaradze, A.G.; Kokhreidze, R.K.; Zambakhidze, R.T. USSR Patent 440,727. 25 Aug 1974. Filed date 6 Mar 1972.
POROSITY;ELECTRODES;MIXTURES;FABRICATION; ETHANOL;SILVER NITRATES;SILVER;WATER;ELECTRIC BATTERIES

3969 INCREASING THE CATALYTIC ACTIVITY OF RARE METAL-DOPED ACTIVATED CARBON FOR OXYGEN ELECTRODES OF ELECTROCHEMICAL CELLS WITH ACID ELECTROLYTES. Boehm, H.; Hartmann, V. (to Licentia Patent-Verwaltungs/G.m.b.H.). German(FRG) Patent 2,305,627. 22 Aug 1974. Filed date 06 Feb 1973. 10p.
CATHODES;METAL-GAS BATTERIES;OXYGEN;DOPED MATERIALS;ACTIVATED CARBON;CATALYSTS;CHEMICAL PREPARATION;FABRICATION

3970 VALVE FOR DEGASSING SECONDARY BATTERIES. Mittermaier, X. (to Mittermaier, F.X., und Soehne Accumulatorenfabrik und Elektrizitaetswerk Isen). German(FRG) Patent 2,305,063. 22 Aug 1974. Filed date 2 Feb 1973. 10p.
ELECTRIC BATTERIES;VALVES;GASES

3971 CATHODE MIX FOR ALKALINE CELL. Tsuchida, T.; Shinoda, K.; Yamamoto, K.; Sakamoto, N.; Nishio, M. (to Fuji Electrochemical Co., Ltd.). US Patent 3,830,661. 20 Aug 1974. Filed date 28 Oct 1972. 4p.
CATHODES;FABRICATION;HYDROXIDES;CHEMICAL PREPARATION;SLURRIES;WATER;CELLULOSE;SPHERES; VERY HIGH PRESSURE;ELECTRIC BATTERIES

3972 ELECTRICAL CONNECTORS AND ELECTRODE HOLDER INTEGRATED IN A GLASS FIBER MAT FOR LEAD SECONDARY BATTERIES. Jonville, P.; Stoehr, H.; Beccu, K.D.; Baronnet, R. (to Battelle Memorial Inst.--International Div.). GE 2,407,426. 14 Aug 1974. Filed date 12 Feb 1973. 15p.
LEAD-ACID BATTERIES;CONNECTORS;ELECTRODES; SUPPORTS;ANODES;FABRICATION;LEAD BASE ALLOYS; ANTIMONY ALLOYS

3973 LEAD--CALCIUM WROUGHT ALLOYS. Prengaman, R.D. (to St. Joe Minerals Corp.). German(FRG) Patent 2,339,779. 14 Aug 1974. Filed date 31 Jan 1973. 28p.
ELECTRIC BATTERIES;LEAD-ACID BATTERIES; ELECTRODES;LEAD BASE ALLOYS;TIN ALLOYS;CALCIUM ADDITIONS;TENSILE PROPERTIES

3974 SOLID ELECTROLYTE SINTERED MATTER SUCH AS IMPERMEABLE BETA-ALUMINA. Hasegawa, M.; Takagi, M. (to Showa Denko K.K.). JA 30,485. 13 Aug 1974. Filed date 6 Nov 1968. 2p.
Chemical preparation for alkali metal--Na batteries. ELECTROLYTES;ALUMINIUM OXIDES; SINTERED MATERIALS;ALKALI METALS;SODIUM;METAL-METAL BATTERIES;CHEMICAL PREPARATION

3975 SODIUM BORATE GLASS COMPOSITIONS AND BATTERIES CONTAINING SAME. Tsang, F.Y. (to Dow Chemical Co.). US Patent 3,829,331. 13 Aug 1974. Filed date 30 Dec 1971. 3p.
SODIUM COMPOUNDS;BORATES;GLASS;SODIUM-SULFUR

BATTERIES;LITHIUM-SULFUR BATTERIES;MEMBRANES; SODIUM IONS;ION EXCHANGE MATERIALS;SODIUM FLUORIDES;MAGNESIUM FLUORIDES;ANODES

3976 STORAGE BATTERY PLATES. Brinkmann, J.; Rasche, M.; Heissmann, W. (to Varta Batteries AG). German(FRG) Patent 2,305,309. 8 Aug 1974. Filed date 3 Feb 1973. 15p.
LEAD-ACID BATTERIES;PLATES;LEAD;FABRICATION; GRIDS;PLASTICS;GLASS;FIBERS;ANODES

3977 HOMOGENEOUS CATHODE MIXTURES FOR SECONDARY ELECTROCHEMICAL POWER-PRODUCING CELLS. Cairns, E.J.; Shimotake, H.; Selman, J.R. (to US AEC). US Patent 3,827,910. 6 Aug 1974. Filed date 30 Nov 1972. 12p.
METAL-NONMETAL BATTERIES;CATHODES; FABRICATION;CHEMICAL PREPARATION;ALKALI METALS; LITHIUM;SULFUR;SELENIUM ALLOYS;THALLIUM ALLOYS; PHOSPHORUS SULFIDES;CHALCOGENIDES

3978 NICKEL ELECTRODES. Pickett, D.F. (to US Dept. of the Air Force). US Patent 3,827,911. 6 Aug 1974. Filed date 21 Feb 1973. 3p.
NICKEL-CADMIUM BATTERIES;CATHODES;CHEMICAL PREPARATION;ALCOHOLS;NICKEL NITRATES;COBALT NITRATES

3979 HALOGEN RETENTION VENT MEANS FOR BATTERY. Zito, R., Jr. (to Zito Co., Inc.). US Patent 3,827,915. 6 Aug 1974. Filed date 3 Feb 1971. 7p.
Patent; rechargeable metal halide battery. ELECTRODES;METAL-GAS BATTERIES;HALOGENS; GRAPHITE;DESIGN;ANODES;CATHODES

3980 BETA-ALUMINA SINTERED MATTER FOR SOLID ELECTROLYTE. Miyake, Y.; Ninaki, S.; Ogino, I. (to Agency of Industrial Sciences and Technology). JA 30,484. 2 Aug 1974. Filed date 2 Aug 1968. 3p.
Chemical preparation. ALUMINIUM OXIDES; ELECTROLYTES;SODIUM-SULFUR BATTERIES;CHEMICAL PREPARATION;SINTERED MATERIALS

3981 SINTERED PVC SEPARATOR FOR BATTERIES. Gruene, H. (to Varta Batterie AG). German(FRG) Patent 2,303,750. 1 Aug 1974. Filed date 26 Jan 1973. 5p.
PVC;SINTERED MATERIALS;BATTERY SEPARATORS; POWDERS;PLASTICIZERS;OCTADECANOIC ACID;LEAD COMPOUNDS;FABRICATION

3982 DENSIMETER FOR LIQUIDS ESPECIALLY BATTERY ELECTROLYTES. Plessis, R. (to Soc. Fulmen; Compagnie Europeenne d'Accumulateurs). German(FRG) Patent 2,403,275. 1 Aug 1974. Filed date 31 Jan 1973. 8p.
DENSIMETERS;LIQUIDS;ELECTROLYTES;LEAD-ACID BATTERIES;THERMISTORS;DESIGN

3983 SYSTEM FOR CONTROLLING A PULSE CONVERTOR FOR ACCUMULATOR CHARGING. Maznev, A.S.; Levitskii, B.Yu.; Dulov, N.N.; Lyamin, K.B. Elektrotekhnika; No. 8, 30-2(Aug 1974). (In Russian).
ELECTRIC BATTERIES;BATTERY CHARGERS;PULSE CONVERTERS;CONTROL SYSTEMS;PULSES;THYRISTORS; ELECTRIC-POWERED VEHICLES

3984 SUBSTITUTION OF SILVER BY VARIOUS METAL IONS IN MODIFIED AGI SOLID ELECTROLYTES. Scrosati, B.; Pistoia, G.; Lazzari, M.; Bicelli, L.P. (Rome Univ, Italy). J. Appl. Electrochem.; 4: No. 3, 201-209(Aug 1974).
The substitution process of silver by various metals in $RbAg_4I_5$ and other solid electrolytes of the AgI-modified type has been investigated. This process is of technological interest since it permits the use of copper, zinc or cadmium instead of silver as anode materials in solid state batteries which utilize these electrolytes. 14 refs.

3985 POROUS COBALT ANODE FOR ALKALINE BATTERIES. Ewe, H.H.; Justi, E.W. GE 2,261,378. 25 Jul 1974. Filed date 15 Dec 1972. 12p.
NiO(OH)/alk./Co; patent. ELECTRIC BATTERIES; COBALT;ANODES;FABRICATION;SINTERING;HIGH PRESSURE;HIGH TEMPERATURE;NICKEL HYDROXIDES; HYDROXIDES

3986 POTASSIUM SILICATE ELECTROLYTE FOR CELLS WITH NEGATIVE ZINC ELECTRODE. Drury, J.S.; Hampson, N.A.; Marshall, A. (to Shell Internationale Research Maatschappij B. V.). German(FRG) Patent 2,402,436. 25 Jul 1974. Filed date 19 Jan 1973. 21p.
Increased lifetime;patent. ZINC-AIR BATTERIES;POTASSIUM HYDROXIDES;POTASSIUM SILICATES;PERFORMANCE;LIFETIME;PASSIVATION; ELECTROLYTES

3987 BATTERY COVER. Kraals, R. US Patent 3,825,447. 23 Jul 1974. Filed date 17 Jul 1972. 4p.
LEAD-ACID BATTERIES;CONTAINERS;SEALS

3988 IMMOBILIZED BATTERY ELECTROLYTE. Cestaro, J.P.; Crosby, L.J. (to NL Industries, Inc.). US Patent 3,930,881. 22 Jul 1974. vp.
An immobilized electrolyte paste adaptable for use in a lead--acid storage battery is discussed. The immobilized electrolyte paste comprises 1.5 to 4.0 parts sulfuric acid having a specific gravity from 1.050 to 1.350 and 1 part organic microparticles inert to sulfuric acid and having a particle diameter of 0.1 to 3 μ. A lead--acid storage battery comprises a battery case; positive and negative lead base plates wherein the positive and negative plates are alternately spaced apart in the battery case; means for maintaining the positive and negative plates in this spaced apart relationship; and an immobilized electrolyte paste which comprises a mixture of 1.5 to 4 parts sulfuric acid having a specific gravity from 1.050 to 1.350 and 1 part organic microparticles inert to sulfuric acid and having a particle diameter of 0.1 to 3 μ.

3989 TUBULAR ELECTRODE FOR ELECTRICAL STORAGE BATTERY. Karlsson, R.A. (to Aktiebolag Tudor). Swedish Patent 368,641. 8 Jul 1974. Filed date 25 Oct 1972. 8p.
Patent; construction. LEAD-ACID BATTERIES; ELECTRODES;TUBES;DESIGN;FABRICATION

3990 BATTERY SEPARATOR. Palmer, N.I.; Sugarman, N.; Grammer, D.O. (to Grace, W.R., and Co.). German(FRG) Patent 2,363,914. 4 Jul 1974. Filed date 21 Dec 1972. 48p.
BATTERY SEPARATORS;FABRICATION;ORGANIC POLYMERS;PLATES;FIBERS;WETTING AGENTS; POLYPROPYLENE;HETEROCYCLIC COMPOUNDS;ORGANIC OXYGEN COMPOUNDS;PHENOLS

3991 BATTERY SEPARATOR. Palmer, N.I.; Sugarman, N. (to Grace, W.R., and Co.).

German(FRG) Patent 2,363,915. 4 Jul 1974. Filed date 21 Dec 1972. 42p.
Patent; fibers of a hydrophobic organic polymer containing a tenside. BATTERY SEPARATORS;SHEETS;FIBERS;ORGANIC POLYMERS; POLYPROPYLENE;FABRICATION;AROMATICS; HETEROCYCLIC COMPOUNDS;ORGANIC OXYGEN COMPOUNDS

3992 HIGH TEMPERATURE BATTERY PACKAGE AND A METHOD OF ASSEMBLING SAME. Beardshear, D.H.; Limbach, R.H. (to Magnavox Co., Fort Wayne, IN). US Patent 3,822,150. 2 Jul 1974. Filed date 15 May 1972. 8p.
ELECTRIC BATTERIES;NICKEL-CADMIUM BATTERIES; LOW TEMPERATURE;HIGH TEMPERATURE;PARAFFIN; CONTAINERS;THERMAL INSULATION;TEMPERATURE CONTROL;SATELLITES

3993 FORMATION PROCESSES OF THE LEAD--ACID BATTERY NEGATIVE PLATES. Pavlov, D.; Iliev, V.; Papazov, G.; Bashtavelova, E. (Bulgarian Acad. Sci., Sofia). J. Electrochem. Soc.; 121: No. 7, 854-60(Jul 1974).
Processes within bulk of the negative plate. LEAD-ACID BATTERIES;ANODES;CHEMICAL REACTIONS; ELECTROCHEMISTRY;PLATES

3994 BATTERY SEPARATOR. Palmer, N.I.; Grammer, D.O. (to Grace, W.R., and Co.). German(FRG) Patent 2,363,913. 27 Jun 1974. Filed date 21 Dec 1972. 47p.
BATTERY SEPARATORS;FABRICATION;POLYPROPYLENE; PLASTICS

3995 HYDROPHILIC DIAPHRAGM. Murata, K.; Nimune, S.; Ashida, K.;. (to Yuasa Battery Co.). Japanese Patent 7,424,985. 26 Jun 1974. Filed date 4 Jun 1970. 3p.
NONE

3996 ELECTRODE OF LITHIUM--ALUMINUM ALLOY. Settle, J.L.; Myles, K.M.; Battles, J.E. (to United States Atomic Energy Commission). US Patent Application 481,285. 20 Jun 1974. 17p.
Patent; preparation. LITHIUM ALLOYS; ALUMINIUM ALLOYS;ANODES;CHEMICAL PREPARATION; FABRICATION;ELECTRIC BATTERIES;LITHIUM-SULFUR BATTERIES

3997 DETERMINING THE CAPACITY OF ELECTRODES OF THE NICKEL--IRON STORAGE BATTERY. Novakovskii, A.M.; Grushkina, S.A.; Kozlova, R.L. USSR Patent 431,586. 05 Jun 1974. Filed date 25 Sep 1972.
IRON-NICKEL BATTERIES;ELECTRODES;PERFORMANCE

3998 PRODUCTION OF A CADMIUM ELECTRODE FOR THE ALKALINE STORAGE BATTERY. Terent'ev, N.K.; Pozin, Yu.M.; Fishman, B.I. USSR Patent 431,584. 5 Jun 1974. Filed date 12 Feb 1973.
ANODES;CADMIUM;FABRICATION;NICKEL;MIXING; SINTERING;PRESSING;SILVER-CADMIUM BATTERIES; NICKEL-CADMIUM BATTERIES;ELECTRIC BATTERIES; ELECTRODES

3999 PRODUCTION OF A SILVER--SILVER OXIDE ELECTRODE FOR THE SILVER--ZINC STORAGE BATTERY. Kukoz, F.I.; Karavaev, V.M.; Kudryavtsev, Yu.D.; Fesenko, L.N. (to Ordzhonikidze, S., Polytechnic Inst., Novocherkassk). USSR Patent 431,585. 5 Jun 1974. Filed date 29 May 1972.
CHEMICAL PREPARATION;CATHODES;SILVER-ZINC BATTERIES;SILVER;SILVER OXIDES;OXIDATION; POTASSIUM HYDROXIDES

4000 BATTERY PASTE PUMPING AND METERING SYSTEM. Larkin, T.M. (to Gates Rubber Co., Denver, Co). US Patent 3,814,628. 4 Jun 1974. Filed date 17 Apr 1972. 6p.
ELECTRIC BATTERIES;ELECTRODES;PLATES; FABRICATION;PUMPS

4001 EFFECT OF THE INCREASE OF POROSITY ON THE CURRENT DISTRIBUTION IN NICKEL HYDROXIDE ELECTRODES CONTAINING RANEY NICKEL. Erdmann, U.; Euler, K.J. Elektrotech. Z., A; 95: No. 6, 339-41(Jun 1974). (In German).
ELECTRIC BATTERIES;NICKEL-CADMIUM BATTERIES; NICKEL-ZINC BATTERIES;IRON-NICKEL BATTERIES; NICKEL HYDROXIDES;CATHODES;ELECTRODES;POROSITY; ELECTRIC CURRENTS;SPATIAL DISTRIBUTION

4002 LITHIUM--MAGNESIUM ELECTRODES IN PROPYLENE, CARBONATE. Nicholson, M.M. (Rockwell Intl. Corp., Canoga Park, CA). J. Electrochem. Soc.; 121: No. 6, 734-8(Jun 1974).
Li deposition, anodic stripping, electrochemistry. LITHIUM ALLOYS;MAGNESIUM ALLOYS;ANODES;ELECTRIC BATTERIES; ELECTROCHEMISTRY;CARBONIC ACID DERIVATIVES; CHEMICAL PREPARATION

4003 REDUCTION OF THE SILVER OXIDE ELECTRODE IN CSOH SOLUTIONS. Wales, C.P. (Nav. Res. Lab., Washington, DC). J. Electrochem. Soc.; 121: No. 6, 727-34(Jun 1974).
Comparison with KOH. REDUCTION;SILVER OXIDES; CESIUM HYDROXIDES;SINTERED MATERIALS;POTASSIUM HYDROXIDES;SILVER;PERFORMANCE;POLARIZATION; COMPARATIVE EVALUATIONS;ELECTROLYTES;ELECTRODES; ELECTRIC BATTERIES;SILVER-CADMIUM BATTERIES; SILVER-ZINC BATTERIES;CATHODES

4004 TURNING A COMPONENT SUPPLY PROBLEM TO ADVANTAGE WITH PLASTICS: RADICAL REDESIGN OF STORAGE BATTERY BOXES. Miller, W.G. Eur. Plast. News; 1: No. 2, 40-42(Jun 1974).
This paper describes R and D work performed by one of the British companies aimed at the replacement of traditional glass containers in emergency lighting batteries with those made of plastics. Design considerations are reported along with material property requirements. Styrene-acrylonitrile (SAN) copolymer has been found to meet these requirements. SAN boxes were made on a giant injection molding machine and tested under working conditions.

4005 SILVER/SILVER CHLORIDE ELECTRODES: SURFACE MORPHOLOGY ON CHARGING AND DISCHARGING. Katan, T.; Szpak, S.; Bennion, D.N. (Lockheed Palo Alto Research Lab., CA). J. Electrochem. Soc.; 121: No. 6, 757-764(Jun 1974).
Transport modes were determined from examinations of morphology for electrochemical oxidation and reduction within electrodes consisting of beds of silver spheres 37.2 μm in diameter in 1N KCl and subjected to 5.0 mA $cm^{-2}$ applied current density. Oxidation proceeded via silver dissolution, probably at dislocation sites, followed by diffusion and, then, deposition of AgCl in characteristic, bulbed mounds which grow together to form layers of approximately uniform thickness. AgCl film thickness, for the case of partially covered underlying silver, was about 3500 A, and the distance from silver dissolution pits to AgCl deposition sites was found to be increased from 4000 to 40,000 A as the local transfer current density became larger within the sphere bed.

Reduction of anodically formed AgCl on partially covered silver proceeded by an opposite path: solution and diffusion of AgCl, and deposition of silver on preferred sites of surrounding bare silver surface.

4006 BATTERY WITH NEGATIVE ELECTRODE OF ALKALI METAL. Lehmann, G. (to Societe des Accumulateurs Fixes et de Traction). French Patent 2,204,900. 24 May 1974. Filed date 30 Oct 1972. 6p.
Li anode with $LiClO_4$ electrolyte in mixed solvent. ELECTRIC BATTERIES;LITHIUM-SULFUR BATTERIES;LITHIUM-CHLORINE BATTERIES; ELECTROLYTES;LITHIUM;ANODES;LITHIUM COMPOUNDS; CHLORATES;ETHERS;ESTERS

4007 BATTERY SEPARATORS MADE FROM POLYMERIC FIBERS. Buntin, R.R. (to Esso Research and Engineering Co., Linden, NJ). US Patent 3,811,957. 21 May 1974. Filed date 29 Jun 1972. 16p.
BATTERY SEPARATORS;FABRICATION;POLYPROPYLENE; POLYSTYRENE

4008 AUTOMATIC BATTERY CHARGER SHUTS ITSELF DOWN. Olson, H. (Stanford Res. Inst., Menlo Park, CA). EDN Mag.; 19: No. 10, 77-8(20 May 1974).
BATTERY CHARGERS;ELECTRONIC CIRCUITS; RECTIFIERS;ELECTRIC POTENTIAL;CONTROL SYSTEMS

4009 IMMOBILIZING AGENTS FOR ELECTROLYTE SOLUTIONS IN BATTERIES. Guth, J.L.; Schutz, R.A.; Wey, R.L.J. French Patent 2,204,050. 17 May 1974. Filed date 23 Oct 1972. 5p.
Patent; keolin. ELECTRIC BATTERIES; ELECTROLYTES;SILICATES;CRYSTALS;KAOLIN

4010 STORAGE BATTERY GAS RECOMBINATION CATALYST DEVICE. Dietz, H. US Patent 3,930,890. 14 May 1974. Priority date 23 May 1973, German, Federal Republic of (F.R. Germany). vp.
A device for promoting catalytic recombination of gases generated in a storage battery is described. It comprises a catalyst body encased in a porous hydrophobic shell consisting of superposed layers of sintered and unsintered polytetrafluoroethylene. The body is of such dimensions and constitution that a number of such bodies may float freely on the electrolyte of a storage battery and that the specific weight of the device as a whole is less than the specific weight of the electrolyte in its condition of lowest battery charge. The catalyst body is constituted largely of a material having a high proportion of void space in its interior and a low bulk density and serving as a carrier for a finally divided catalyst material.

4011 SUPPORT FRAME FOR THE ACTIVE MATERIAL OF ELECTRODES FOR BATTERIES OR FUEL CELLS. Hoppenrath, M.; Benczur-Urmossy, G. (to Deutsche Automobilgesellschaft mbH). German(FRG) Patent 2,251,160. 9 May 1974. Filed date 19 Oct 1972. 11p.
A graphite fiber body was 90 percent saturated with acetone and then transferred to a bath containing $NiCl_2.6H_2O$ 30, $NH_3$ 100, and $NaBH_4$ 3 g/l. After 24 hr, more $NaBH_4$ (1.5 g/l) was added. After 2 days 3 g Ni (containing B) was deposited on the graphite felt.

4012 ACTIVATED STABLE OXYGEN ELECTRODE. Zimmermann, G.; Schonborn, M.; Magenau, H.; Jahnke, H.; Becker, B. (to Robert Borsch GmbH). US Patent 3,930,884. 8 May 1974. Priority date 25 May 1973, German, Federal Republic of (F.R. Germany). vp.
A stable oxygen electrode which retains its useful catalytic activity over a long service life is described comprising an electrode carrier containing an activated transition metal chelate of 5,14-dihydrodibenzo(5,9,14,18)-tetraaza(14)-annulene, said activated metal chelate having been activated by heating in an inert gas atmosphere at a temperature between about 600°C and 1000°C for a minimum time of 5 minutes.

4013 PLATE GRID IN USE FOR A PLATE FOR A LEAD STORAGE BATTERY. Ikari, S.; Hayakawa, T.; Kamikawa, Y.; Imai, F. (to Keishin Matsumoto). US Patent 3,944,431. 3 May 1974. vp.
A plate grid for use in a plate for a lead storage battery is described. It contains a woven member having several spaced latitudinal wire members of acid-resisting material and several spaced longitudinal wire members which are woven together. The longitudinal wire members each include a wire element of acid-resisting material and a wire element of electrically conductive material selected from a group consisting of lead and lead alloy. The electrically conductive wire element is wound around acid-resisting wire element of the longitudinal wire member. The grid also contains a collector of electrically conductive material selected from a group consisting of lead and lead alloy. The collector is attached to one of the ends of the longitudinal wire members, whereby the collector is electrically connected to the electrically conductive wire elements of the longitudinal wire members.

4014 BATTERY ELECTROLYTE. Kalochoritis, D.; Gavalas, P. SF 7,796. 2 May 1974. Filed date 2 Nov 1972. 4p.
$CuSO_4$ X $5H_2O$, $Al_2(SO_4)_3$ X $18H_2O$, $H_2SO_4$. LEAD-ACID BATTERIES;ELECTROLYTES

4015 CATHODIC BEHAVIOR OF CUS, $MOO_3$, AND $MNO_2$IN LITHIUM CELLS. Dampier, F.W. (ESB Inc., Yardley, PA). J. Electrochem. Soc.; 121: No. 5, 656-68(May 1974).
METAL-NONMETAL BATTERIES;METAL-METAL OXIDE BATTERIES;LITHIUM;MOLYBDENUM OXIDES;MANGANESE OXIDES;COPPER SULFIDES;CATHODES;LITHIUM COMPOUNDS;CHLORATES;CARBONIC ACID ESTERS;FURANS; DME;EFFICIENCY

4016 DISTRIBUTION OF POTENTIAL AND ELECTROCHEMICAL REACTION RATE IN MOLTEN POLYSULPHIDE ELECTRODES. Gibson, J.G. (Railw. Tech. Cent., Derby, England). J. Appl. Electrochem.; 4: No. 2, 125-34(May 1974).
SODIUM-SULFUR BATTERIES;ELECTROCHEMISTRY; ELECTRIC POTENTIAL;CATHODES;CHEMICAL REACTION KINETICS;SPATIAL DISTRIBUTION;CARBON;SULFUR; SODIUM SULFIDES;THICKNESS;POLARIZATION; PASSIVATION;MATHEMATICAL MODELS;ELECTRIC CONDUCTIVITY

4017 EXPANDER ACTION IN THE LEAD--ACID BATTERY. 2. INHIBITION OF NUCLEATION PROCESSES. Brennan, M.P.J.; Hampson, N.A. (Univ. of Technol., Loughborough, Leics, England). J. Electroanal. Chem. Interfacial Electrochem.; 52: No. 1, 1-10(25 Apr 1974).
LEAD-ACID BATTERIES;ANODES;BATTERY CHARGING; NUCLEATION;CRYSTAL GROWTH;REDUCTION;PASSIVATION; LEAD SULFATES;FILMS;ELECTROCHEMISTRY;

CRYSTALLIZATION;LEAD;LEAD COMPOUNDS; PERCHLORATES;ADDITIVES;ORGANIC COMPOUNDS; LIFETIME

4018 METHOD AND APPARATUS FOR PASTING BATTERY PLATES. Pankow, H.G.; Larkin, T.M.; Young, R.L.; McClelland, D.H. (to Gates Rubber Co.). US Patent 3,951,688. 23 Apr 1974. vp.

A method for pasting lead--acid battery plate porous substrates with an electrochemically active thixotropic paste composition which maintains a non-plastic condition during the pasting operation comprises the following steps: circulating the paste in a substantially closed loop network so as to agitate and thoroughly mix the paste; diverting a predetermined volumetric flow rate of the paste from the loop network to a discharge nozzle; discharging the paste in the form of a thin ribbon through the nozzle positioned in close proximity to the substrate at the predetermined volumetric flow rate without substantially deforming the substrate, while simultaneously moving the substrate horizontally beneath the nozzle in a continuous manner to deposit the paste onto the upper surface of the moving substrate to form a pasted substrate; moving the pasted substrate through the nip of a set of driven rolls, the rolls being spaced apart a predetermined distance; and compressing the paste into the interstices of the porous substrate to produce a plate of desired thickness and density of paste.

4019 OXYGEN ELECTRODE MATERIAL. Kudo, T.; Yoshida, M.; Okamoto, O. (to Hitachi, Ltd.). US Patent 3,804,674. 16 Apr 1974. Filed date 19 May 1971. 6p.

FUEL CELLS;METAL-GAS BATTERIES;CATHODES; OXYGEN;NEODYMIUM OXIDES;SAMARIUM OXIDES;BARIUM OXIDES;CALCIUM OXIDES;STRONTIUM OXIDES;COBALT OXIDES;MIXTURES;MATERIALS

4020 APPARATUS AND METHOD FOR MAKING BATTERY ELECTRODES. Chevet, R. (to Compagnie Generall d'Electricite). French Patent 2,199,617. 12 Apr 1974. Filed date 19 Sep 1972. 6p.

Patent; pouring suspension of soot, teflon, and cellulose through cylindrical Ni mesh and heat testing. ELECTRODES;FABRICATION;CYLINDERS; ALCOHOLS;TEFLON;CELLULOSE;CARBON;NICKEL;HEAT TREATMENTS;ELECTRIC BATTERIES

4021 SILVER--TUNGSTEN CARBIDE ELECTRODE. (to Siemens, AG). French Patent 2,198,786. 5 Apr 1974. Filed date 12 Sep 1972. 10p.

ELECTRIC BATTERIES;FUEL CELLS;ELECTRODES; CHEMICAL PREPARATION;TUNGSTEN CARBIDES;SILVER; FABRICATION

4022 ANTIMONY PLATING OF LEAD--ACID STORAGE BATTERIES GRIDS. Hughel, T.J.; Hammar, R.H. (to General Motors Corp.). US Patent 3,933,524. 5 Apr 1974. vp.

A grid for a Faure-type lead--acid storage battery positive plate comprises a substantially nonantimonial lead alloy substructure having an antimony deposit on its surface. The deposit density is at least about 0.0002 grams per square centimeter but less than about 0.00132 grams per square centimeter.

4023 EFFECT OF ADDITIVES ON THE REACTION MECHANISM OF THE PB/PBSO$_4$ ELECTRODE. Simon, A.C.; Caulder, S.M.; Gurlusky, P.J.; Pierson, J.R. (Nav. Res. Lab., Washington, DC). J. Electrochem. Soc.; 121: No. 4, 463-7(Apr 1974).

BaSO$_4$, lignin. LEAD-ACID BATTERIES;CHEMICAL REACTION KINETICS;ADDITIVES;LIGNIN;BARIUM SULFATES;ANODES;LIFETIME;PASSIVATION;CRYSTAL GROWTH;LEAD

4024 SCANNING ELECTRON MICROSCOPE INVESTIGATIONS ON SILVER OXIDE ELECTRODES. Franssen, H.; Haeusler, E.; Boehnstedt, W. (Friemann and Wolf, Duisburg, Germany). Metalloberflaeche; 28: No. 4, 140-2(Apr 1974). (In German).

Morphological changes in sintered powder metallurgy electrodes due to oxidation during cycling. ELECTRON MICROSCOPY;SILVER OXIDES; SINTERED MATERIALS;ELECTROCHEMISTRY;OXIDATION; OPERATION;BATTERY CHARGING;SILVER-CADMIUM BATTERIES;SILVER-ZINC BATTERIES;CATHODES; ELECTRIC BATTERIES;ELECTRODES

4025 SCANNING ELECTRON MICROSCOPE INVESTIGATIONS ON SILVER OXIDE ELECTRODES. Franssen, H.; Haeusler, E.; Boehnstedt, W. (Friemann and Wolf, Duisburg, Ger.). Metalloberflaeche; 28: No. 4, 140-142(Apr 1974). (In German).

Changes in the morphology of sintered powder metallurgically produced silver electrodes, caused by electrochemical oxidation during initial charging and discharging of electric batteries, are illustrated by electron micrographs. The resulting roughening and, therefore, size increase of the particle surfaces explains the increased efficiency.

4026 ELECTRODE FORMED OF LITHIUM AND A METAL CONDUCTOR METALLURGICALLY BOUND. (to E. I. du Pont de Nemours and Co.). French Patent 2,196,850. 22 Mar 1974. Filed date 25 Aug 1972. 12p.

ANODES;LITHIUM;FABRICATION;SHEETS;STAINLESS STEELS;SUBSTRATES;ZINC;BONDING;LITHIUM-SULFUR BATTERIES;ELECTRIC BATTERIES

4027 METHOD OF MAKING BATTERY PLATE GRIDS FOR LEAD--ACID BATTERIES AND ALLOYS THEREFOR. Barnes, S.C.; Lawrie, R.J. (to Joseph Lucas (Batteries) Ltd.). US Patent 3,939,009. 22 Mar 1974. Priority date 7 Apr 1973, United Kingdom of Great Britain and Northern Ireland (UK). vp.

A method of manufacturing a battery plate grid for a lead--acid battery is explained. A molten alloy is produced which consists of calcium + lithium (0.22 to 1.04 at. percent), aluminium (0.035 to 0.25 at. percent), and lead. The atomic percentage of lithium is not less than 0.15 and does not exceed 0.90, and the atomic percentage of calcium is not less than 0.07 and does not exceed 0.49. The molten alloy is then cast into the shape of the grid.

4028 FUEL CELL ELECTRODE. Murata, T.; Maeda, Y.; Tsuchida, T.; Shinoda, K.; Yamamoto, K. (to Fuji Electrochemical Co., Ltd.). German(FRG) Patent 2,337,646. 21 Mar 1974. Filed date 31 Aug 1972. 12p.

The fabrication of an oxygen electrode for fuel cells or zinc--air batteries is described. A silver oxide--activated carbon--teflon mixture is compacted on a nickel screen.

4029 BATTERY CASING AND HERMETICALLY SEALED SODIUM--SULFUR BATTERY. Mitoff, S.P.; Powers, R.W.; Breiter, M.W. (to General Electric Co.). US Patent 3,960,596. 4 Mar 1974. vp.

A battery casing comprises a ceramic ring, an inner casing of a solid sodium ion-conductive material with one open end, a glass seal sealing a portion of the outer wall of the inner casing adjacent its open end within and to the ceramic ring, a first outer metallic casing with opposite open ends and a flange at one open end, and a second outer metallic casing with opposite open ends. The first outer metallic casing surrounds the inner casing and is spaced away from it. The flange of the first outer metallic casing is adjacent the ceramic ring, a glass seal sealing the flange of the first outer metallic casing to one surface of the ceramic ring. The first outer metallic casing and the inner casing define a completely open chamber between the exterior surface of the inner casing and the interior surface of the outer casing. There is a removable metallic closed end for the opposite open end of the first outer casing. The second outer metallic casing with opposite open ends and a flange at one open end is positioned with the flange adjacent the ceramic ring, whereby the second outer metallic casing is spaced from and extends in an opposite direction to the first outer metallic casing portion. A glass seal seals the flange of the second outer metallic casing to the opposite surface of the ceramic ring. There is a second removable metallic closed end for the opposite open end of the second outer metallic casing.

4030 ZINC-CONTAINING ELECTRODE. Kandler, L. (to Rheinisch-Westfalisches Elektrizitalswerk Aktiengesellschaft). US Patent 3,930,883. 27 Feb 1974. Priority date 16 Aug 1969, German, Federal Republic of (F.R. Germany). vp.

A method of making a negative electrode for an alkaline accumulator is described. It consists of the following steps: (1) electrolytic deposition of zinc and calcium upon a conductive support in the form of Zn, $Zn(OH)_2$, and $Ca(OH)_2$ from an electrolytic bath containing zinc ions, calcium ions, and nitrate ions with the ratio of zinc ions to calcium ions made relatively high and establishing the proportions of zinc and calcium deposited on the support in a first electrochemically active layer directly upon the support; (2) electrochemical deposition on the first electrochemically active layer of an outer electrochemically active layer containing zinc and calcium as Zn, $Zn(OH)_2$, and $Ca(OH)_2$ from an electrolyte containing zinc ions, calcium ions, and nitrate ions with the ratio of zinc ion to calcium ion made less than in step (1), whereby the outer layer has a smaller ratio of zinc to calcium; and (3) formation of the above-mentioned layers by electrolyzing same to transform the deposited zinc ion of the layers into elemental zinc.

4031 FORMING AN ELECTRODE OF MIXED CATALYST POWDER. Paynter, J. (to General Electric Co.). US Patent 3,793,083. 19 Feb 1974. Filed date 30 Dec 1968. 8p.

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4032 VARYING THE INTERNAL RESISTANCE IN THE ELECTROFORMATION OF STORAGE-BATTERY PLATES WITH CURRENT OF CHANGING POLARITY. Gisin, S.S. Elektroprom-st. Priborostr.; 9: No. 2, 60-3(Feb 1974). (In Bulgarian).

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designed for lead--acid batteries. BATTERY CHARGERS;LEAD-ACID BATTERIES;DESIGN;FABRICATION

4034 CHANGE OF THE ELECTROLYTE CONCENTRATION IN METALLOCERAMIC CADMIUM ELECTRODES OF ALKALINE STORAGE BATTERY. Uvarov, V.B.; Boldin, R.V.; Rotinyan, A.L. (Leningrad Technological Inst.). Elektrokhimiya; 10: No. 2, 334-336(Feb 1974). (In Russian).

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4036 AUTOMATIC CHARGING OF LEAD ACID BATTERIES USING SILICON CONTROLLED RECTIFIERS. Manoharan, L.C. (Natl. Aeronaut. Lab., Bangalore, India). Int. J. Electron.; 36: No. 2, 231-8(Feb 1974).

LEAD-ACID BATTERIES;BATTERY CHARGERS; RECTIFIERS;OPERATION

4037 ANODIC POLARIZATION OF ALUMINUM IN ORGANIC ELECTROLYTES. Matsuda, Y.; Ouchi, Y.; Tamura, H. (Yamaguchi Univ., Tokiwadai, Ube, Japan). J. Appl. Electrochem.; 4: No. 1, 53-6(Feb 1974).

Nitromethane, acetonitile, propylene carbonate, formamide, or tetrahydrofuran in $AlCl_3$. ALUMINIUM;POLARIZATION;ELECTRODES; ELECTROLYTES;ANODES;ELECTRIC BATTERIES;NITRO COMPOUNDS;CARBONIC ACID ESTERS;NITRILES; FORMAMIDE;FURANS;ALUMINIUM CHLORIDES; ELECTROCHEMISTRY

4038 VARIABLE COMPOSITION OF BASIC LEAD SULFATES. Dapo, R.F. (Gould Inc., Mendota Heights, MN). J. Electrochem. Soc.; 121: No. 2, 253-254(Feb 1974).

LEAD-ACID BATTERIES;LEAD SULFATES;CHEMICAL COMPOSITION;MATERIALS;CHEMICAL PREPARATION

4039 STORAGE BATTERY PLATE AND MANUFACTURING PROCESS THEREFOR. Brinkmann, J.; Rasche, M.; Heissmann, W. (to Varta Batterie Aktiengesellschaft). US Patent 3,944,432. 29 Jan 1974. Priority date 3 Feb 1973, German, Federal Republic of (F.R. Germany). vp.

A storage battery plate comprises a grid formed of plastic strips and plastic cross-connections between the strips, the strips defining channels for containing the active mass; a grid of lead bars recessed within the channels; active mass substantially filling the channels and surrounding the recessed lead bars, the active mass being positioned to leave edges of the plastic strips and cross-connections exposed; and electrolyte-permeable fibrous mats covering the grid on both sides, the mats being firmly attached to the exposed edges of the plastic strips and plastic cross-connections.

4040 METAL--AIR BATTERIES AND FUEL CELLS. Zaromb, S. US Patent 3,788,899. 29 Jan

1974. Filed date 12 Apr 1967. 8p.
The battery comprises an anode, a depolarized cathode, liquid electrolyte and circulation means, electrolyte container, and means to produce changes in the volume of electrolyte and thereby control the current density at the surfaces of the anode and the cathode. The anode may be a consumable metal, especially Al. The volume changes are effected by expanding or collapsing an expandable pocket in the container.

4041 CATHODES FOR METAL--AIR-TYPE FUEL CELLS. Conzani, V. (to Ricerche Conversione Energia). German(FRG) Patent 3,255,984. 10 Jan 1974. Priority date 26 Jun 1972, Italy. 9p.
The porous metal cathodes were treated with a poly(tetrafluoroethylene) suspension in vacuo. The porous cathode was impregnated 3 times with a 30 percent teflon suspension of grain size 0.2-0.3 μ at 12 mm pressure and dried at 80°. Then the cathode was coated with a 60 percent teflon suspension, dried again, and sintered at 320°.

4042 CATHODE FOR METAL--AIR-TYPE FUEL CELLS. Conzani, V. (to Ricerche Conversione Energia, SpA). German(FRG) Patent 2,255,985. 10 Jan 1974. Filed date 26 Jun 1972. 11p.
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4130 ELECTROMAGNETIC MONITORING OF THE DEGREE OF OXIDATION OF POWDER-METALLURGY NICKEL [FOR ELECTRODES FOR ALKALINE BATTERIES]. Bogdanov, V.I.; Kudryavtsev, Yu.D.; Fesenko, L.N.; Fateeva, V.N.; Maslii, I.I. Tr. Novocherkassk. Politekh. Inst.; No. 297, 53-6(1974).
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4131 FUEL CELLS. Sanglay, M.B.; Catacutan, J.E.; Terrado, E.N. (Proj. Sta. Barbara, Nav. Stn., Cavite, Philippines). Philipp. J. Sci.; 103: No. 2, 141-6(1974).
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4132 DC CONVERTER FOR CHARGING BATTERIES ON VEHICLES. Troll, G. AEG-Telefunken Prog.; No. 1, 6-12(1974).
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4133 ION-CONDUCTING POLYMERIC AND POLYMER-INORGANIC SEPARATOR MEMBRANES FOR THE CURRENT SOURCES OF A SILVER--ZINC ELECTROCHEMICAL SYSTEM. Toroptseva, T.N.; Kanaeva, S.N.; Basova, I.G.; Neklyudova, O.V.; Kabalinskii, I.N.; Osipova, Z.A.; Sporykhina, I.V. (Vses. Nauchno-Issled. Proektn.-Konstr. Tekhnol. Inst. Istochnikov Toka, Moscow, USSR). pp 483-5 of Tezisy Dokl. - Vses. Soveshch. Elektrokhim., 5th. Volume 2. Moscow, USSR; Vses. Inst. Nauchn. Tekh. Inf. (1974).
SILVER-ZINC BATTERIES;BATTERY SEPARATORS; MEMBRANES;POLYMERS;PERFORMANCE;CELLULOSE;PVA; LACTAMS;TEFLON;ZIRCONIUM OXIDES

4134 REASONS FOR THE POISONING EFFECT OF SMALL QUANTITIES OF SOME IMPURITIES ON THE CATHODE REDUCTION PROCESS FOR METAL OXIDES AND HYDROXIDES IN AN ALKALI SOLUTION. Rozovskii, V.M.; Solov'eva, N.A. (Nauchno-Issled. Inst. Khim. Istochnikov Toka, Saratov, USSR). pp 480-2 of Tezisy Dokl. - Vses. Soveshch. Elektrokhim., 5th. Volume 2. Moscow, USSR; Vses. Inst. Nauchn. Tekh. Inf. (1974).
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4135 SELF-DISCHARGE MECHANISM OF A POWDER-METALLURGY NICKEL OXIDE ELECTRODE IN CONCENTRATED POTASSIUM HYDROXIDE SOLUTIONS. Malandin, O.G.; Bityutskii, P.N.; Tikhonova, T.S. (Nauchno-Issled. Inst. Khim. Istochnikov Toka, Saratov, USSR). pp 465-7 of Tezisy Dokl. - Vses. Soveshch. Elektrokhim., 5th. Volume 2. Moscow, USSR; Vses. Inst. Nauchn. Tekh. Inf. (1974).
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4136 STRUCTURE OF A DOUBLE ELECTRIC LAYER AND FEATURES OF THE ELECTRODE PROCESSES ON A SODIUM NICKELATE SINGLE CRYSTAL. Volynskii, V.A.; Chernykh, Yu.N. (Nauchno-Issled. Inst. Khim.

Istochnikov Toka, Saratov, USSR). pp 445-7 of Tezisy Dokl. - Vses. Soveshch. Elektrokhim., 5th. Volume 2. Moscow, USSR; Vses. Inst. Nauchn. Tekh. Inf. (1974).
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4137 DISSOLUTION AND PASSIVATION OF METALS IN ALKALINE SOLUTIONS IN THE PRESENCE OF SURFACTANTS. Arkhangel'skaya, Z.P.; Reshetova, G.N.; Zgonnik, V.N.; Alekseeva, M.E.; Fedorova, T.V. (Vses. Nauchno-Issled. Akkumulyatornyi Inst., Leningrad, USSR). pp 439-41 of Tezisy Dokl. - Vses. Soveshch. Elektrokhim., 5th. Volume 2. Moscow, USSR; Vses. Inst. Nauchn. Tekh. Inf. (1974).
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4138 EFFECT OF SOLVENT NATURE ON THE KINETICS OF ELECTROCHEMICAL REACTIONS OF SALT AND OXIDE ELECTRODES. Povarov, Yu.M. (Inst. Elektrokhim., Moscow, USSR). pp 477-9 of Tezisy Dokl. - Vses. Soveshch. Elektrokhim., 5th. Volume 2. Moscow, USSR; Vses. Inst. Nauchn. Tekh. Inf. (1974).
SOLVENTS;CHEMICAL REACTION KINETICS; ELECTROCHEMISTRY;OXIDES;ELECTRODES;WATER; CARBONIC ACID ESTERS;LACTONES;FURANS;ELECTRIC BATTERIES;MOLYBDENUM OXIDES;VANADIUM OXIDES; SYNTHESIS;REDUCTION;MERCURY CHLORIDES;THALLIUM CHLORIDES;COATINGS;SILVER CHLORIDES;DISSOLUTION

4139 DEVELOPMENT OF A COMPACT, HIGH-CAPACITY $FES_2$ ELECTRODE. Shimotake, H.; Walsh, W.J. (Argonne Natl. Lab., IL). Am. Chem. Soc., Div. Fuel Chem., Prepr.; 19: No. 5, 59-66(1974).
FABRICATION;PYRITE;DESIGN;OPERATION; STABILITY;ELECTRODES;ELECTRIC BATTERIES; CATHODES;LITHIUM-SULFUR BATTERIES;SODIUM-SULFUR BATTERIES

4140 EFFECT OF MATRIX STRUCTURE ON THE ELECTROCHEMICAL PERFORMANCE OF P/M IRON ELECTRODES IN AN ALKALINE BATTERY ENVIRONMENT. Hancock, H.A.; Strasser, J.A. (Nova Scotia Technical Coll., Halifax). pp 13-39 of Modern development in powder metallurgy. Volume 8. Proceedings of 4th international powder metallurgy conference, Toronto, Ontario, 15-20 Jul 1973. Princeton, NJ; Met. Powder Ind. Fed. (1974).
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PERFORMANCE;HYDROXIDES;POWDER METALLURGY; POROSITY;SURFACES;IRON-NICKEL BATTERIES;ANODES; ELECTRIC BATTERIES;ELECTRODES

4141 REDUCTION OF OXTGEN ON NICKEL--COBALT OXIDES. II. CORRELATION BETWEEN CRYSTAL STRUCTURE AND ACTIVITY OF $CO_2NIO_4$ AND RELATED OXIDES. King, W.J.; Tseung, A.C.C. (City Univ., London). Electrochim. Acta; 19: No. 8, 493-498(1974).
The implications of the substitution of nickel for cobalt in $Co_3O_4$ to give $Co_2NiO_4$ are discussed. From the effects of substitution of other ions into $Co_2NiO_4$ its curious properties may partly be understood. The cations present are unable to satisfy the requirements of both crystallographic siting and oxidation state to fit the classical spinel distribution. The result is a weakening of the crystal lattice and hence rather loosely bonded oxygen, e.g., possibly as $O^-$ instead of $O^{2-}$. This factor causes the low thermal stability and the exceptional activity towards oxygen reduction, and is maximized by incorporating the highest possible proportion of nickel and then heat-treating the catalyst near its point of breakdown. The importance of preparing the oxide in complete absence of $OH^-$ or $H_2O$ is deduced. A site and charge distribution for $Co_2NiO_4$ based on this work and other published data is advanced. The importance of the ferrimagnetic order remains to be clarified. The electrocatalyst is gradually and irreversibly deactivated on exposure to alkaline electrolyte. A mechanism for this unfortunate property is suggested.

4142 REDUCTION OF OXYGEN ON NICKEL--COBALT OXIDES. I. THE INFLUENCE OF COMPOSITION AND PREPARATION METHOD ON THE ACTIVITY OF NICKEL--COBALT OXIDES. King, W.J.; Tseung, A.C.C. (City Univ., London). Electrochim. Acta; 19: No. 8, 485-491(1974).
Nickel cobalt oxides were prepared by coprecipitation, freeze drying and nitrate decomposition. The resistivity, surface area, crystal structure and electrochemical activity of the powders were determined. The highest activity was found in freeze dried samples with the composition $Co_2NiO_4$ and the spinel structure. TGA and x-ray analysis showed that the spinel phase is metastable and begins to change to a cubic phase at about 450°C, significantly reducing the electrochemical performance. Maximum activity in the catalyst is obtained by heat-treating it to this point.

4143 EFFECT OF LEAD SALT ADDITIONS ON THE PROPERTIES OF A ZINC OXIDE ELECTRODE IN ALKALINE ELECTROLYTES. Ravdel, A.A.; Novikova, N.A.; Levinzon, L.M.; Musakina, A.A.; Larionova, G.V. Sb. Rab. Khim. Istochnikam Toka; 9: 128-131(1974). (In Russian).
SILVER-ZINC BATTERIES;LEAD COMPOUNDS; ACETATES;ADDITIVES;POTASSIUM HYDROXIDES;ZINC OXIDES;PERFORMANCE;ANODES;ELECTROLYTES

4144 FUEL CELLS WITH LIQUID FUEL. I. OXYGEN ELECTRODE. Constantinescu, D.; Danciu, E.; Atanasiu, I. Rev. Chim. (Bucharest); 25: No. 2, 119-124(1974). (In Russian).
The subject of Zn--O cells is discussed with emphasis on the oxygen electrode. Determination of the structure and electrochemical properties of the electrode, preparation of a porous, Teflon-covered electrode, and preparation of catalysts is included. (RWR)

4145 BIG CHANGE IN PRODUCT CALLS FOR INNOVATIVE CUSHIONING, PACKAGING. Ostrander, H.L. (Western Electric Co., Springfield, NJ). Package Eng.; 19: No. 10, 60-63(1974).
Work performed by Western Electric Company to develop a suitable package for a new, round lead--acid storage battery for telephone central offices is reported. Configuration study was followed by materials testing with particular attention to shock resistance. PS foam was selected and used for field trials. In all these tests scrutiny revealed batteries intact. This package has demonstrated its reliability.

4146 DEVELOPMENT AND TEST OF ZINC AIR BATTERIES FOR MOTOR VEHICLES. (Zinc Air Cell Research Group). Ch'ing-Hua Ta-Hsueh Hsueh-Pao; No. 4, 76-84(Dec 1973).
ZINC-AIR BATTERIES;TESTING;PERFORMANCE; CATHODES;ELECTRIC-POWERED VEHICLES

4147 CHEMICAL AND ELECTROCHEMICAL BEHAVIOR OF LITHIUM ELECTRODES IN DIMETHYL SULFITE, ELECTROLYTIC SOLUTIONS. Tiedemann, W.H.; Bennion, D.N. (Univ. of Calif., Los Angeles). J. Electrochem. Soc.; 120: No. 12, 1624-8(Dec 1973).
$LiClO_4$--dimethyl sulfide. ORGANIC SULFUR COMPOUNDS;ELECTROCHEMISTRY;CHEMICAL REACTIONS; LITHIUM;ELECTRODES;ELECTRIC BATTERIES; ELECTROLYTES;CHLORATES;LITHIUM COMPOUNDS

4148 PHASE COMPOSITION OF ELECTRODE PASTES IN LEAD STORAGE BATTERIES. Rusin, A.I.; Dasoyan, M.A. J. Appl. Chem. USSR (Engl. Transl.); 46: No. 12, 2799-2802(Dec 1973).
LEAD-ACID BATTERIES;ELECTRODES;THERMODYNAMIC PROPERTIES;EQUILIBRIUM;WATER;SULFURIC ACID;LEAD; POWDERS;LEAD SULFATES;LEAD OXIDES;PHASE STUDIES; CHEMICAL COMPOSITION

4149 MIXED SOLVENTS FOR HIGH AND LOW TEMPERATURE ORGANIC ELECTROLYTE BATTERIES. Dey, A.; Sullivan, B.P. (to P. R. Mallory and Co., Inc.). US Patent 3,947,289. 23 Nov 1973. vp.
An electrolyte for use in active-metal high-potential electrochemical cells is described. It comprises an active metal salt dissolved in a nonaqueous solvent system comprising (a) at least 10 volume percent of tetrahydrofuran or N-nitrosodimethylamine-butyrolactone, 1,3-dioxolane, dimethoxyethane, bis (2-ethoxy) ethyl ether, bis (2-methoxy) ethoxy-ethyl ether and mixtures thereof.

4150 CONTROLLED POROSITY AND PORE SIZE SUBSTRATES FOR NICKEL--CADMIUM CELLS. Gordy, D.J.; Luksha, E.; Menard, C.J. (Gould Labs., Mendota Heights, MN). Contract NAS5-21097. J. Electrochem. Soc.; 120: 1447-51(Nov 1973).
NICKEL-CADMIUM BATTERIES;ELECTRODES;POROSITY; FABRICATION

4151 HYDROGEN-LOSS CONCEPT OF BATTERY FAILURE: THE $PBO_2$ ELECTRODE. Caulder, S.M.; Murday, J.S.; Simon, A.C. (Naval Res. Lab., Washington, DC). J. Electrochem. Soc.; 120: No. 11, 1515-16(Nov 1973).
LEAD-ACID BATTERIES;FAILURES;CATHODES; HYDROGEN;REDUCTION

4152 ZINC--AIR CELL WITH NEUTRAL ELECTROLYTE. Jindra, J.; Mrha, J.; Musilova, M. (Czech. Acad. Sci., Prague). J. Appl. Electrochem.; 3: No. 4, 297-301(Nov 1973).
Behavior of air cathode and Zn anode. ZINC-AIR BATTERIES;CATHODES;ELECTROLYTES;ELECTRIC CURRENTS;ANODES;CORROSION;ZINC

4153 RESIN SHEET OR STRIP WITH POROUS COATING, USEFUL AS ELECTRODE SEPARATOR. Honda, S.; Hata, H.; Simura, Y.; Une, S. (to Sekisui Chemical Co., Ltd.). German(FRG) Patent 2,415,076. 10 Oct 1973. Filed date 30 Mar 1973. 54p.
Patent; fabrication procedures. RESINS; BATTERY SEPARATORS;POLYETHYLENES;OXIDES;SILICON OXIDES;DIATOMACEOUS EARTH;FOILS;FABRICATION; POLYPROPYLENE;CALCIUM HYDROXIDES;MAGNESIUM HYDROXIDES

4154 SOME ASPECTS OF SODIUM--SULFUR CELL OPERATION. Fally, J.; Lasne, C.; Lazennec, Y.; Margotin, P. (Compagnie Generale Electricite, Marcoussis, Essonne, France). J. Electrochem. Soc.; 120: No. 10, 1292-5(Oct 1973).
β-alumina electrolyte. SODIUM-SULFUR BATTERIES;OPERATION;ALUMINIUM OXIDES;CARBON; HIGH TEMPERATURE;LIFETIME;PERFORMANCE

4155 STUDY OF A BETA-ALUMINA ELECTROLYTE FOR SODIUM--SULFUR BATTERY. Faelly, J.; Lasne, C.; Lazennec, Y.; Le Cars, Y.; Margotin, P. (Compagnie Generale Electricite, Marcoussis, Essonne, France). J. Electrochem. Soc.; 120: No. 10, 1296-8(Oct 1973).
SODIUM-SULFUR BATTERIES;ELECTROLYTES; ALUMINIUM OXIDES;CRYSTAL STRUCTURE;PHASE DIAGRAMS;VERY HIGH TEMPERATURE;TUBES; FABRICATION

4156 STUDY OF A BETA-ALUMINA ELECTROLYTE FO SODIUM--SULFUR BATTERY. Fally, J.; Lasne, C.; Lazennec, Y.; Le Cars, Y.; Margotin, P. (GE, Essonne, France). J. Electrochem. Soc.; 120: No. 10, 1296-8(Oct 1973).
SODIUM-SULFUR BATTERIES;ELECTROLYTES;SODIUM COMPOUNDS;ALUMINATES;ALUMINIUM OXIDES;SODIUM COMPOUNDS;VERY HIGH TEMPERATURE;TUBES; FABRICATION;CERAMICS;PHYSICAL PROPERTIES; ELECTRICAL PROPERTIES;PHASE DIAGRAMS

4157 INFLUENCE OF CONDUCTIVITY AND POROSITY ON THE BEHAVIOR OF THE IRON PLATE IN AN ALKALINE STORAGE CELL. Novakovskii, A.M.; Grushkina, S.A.; Kozlova, R.L. (All-Union Storage Battery Sci.-Res. Inst., USSR). J. Appl. Chem. USSR (Engl. Transl.); 46: No. 10, 2324-7(Oct 1973).
Effects of introducing As, Sb, Ni, Cd, or Sn. PLATES;ELECTRIC CONDUCTIVITY;POROSITY; HYDROXIDES;ADDITIVES;ARSENIC;ANTIMONY;NICKEL; CADMIUM;TIN;PASSIVATION;PERFORMANCE;POWDER METALLURGY;IRON-NICKEL BATTERIES;ANODES; ELECTRIC BATTERIES

4158 INFLUENCE OF ELECTRICAL CONDUCTIVITY OF THE ACTIVE MATERIAL ON THE BEHAVIOR OF THE IRON PLATE IN AN ALKALINE STORAGE CELL. Novakovskii, A.M.; Grushkina, S.A.; Kozlova, R.L. (All-Union Storage Battery Sci.-Res. Inst., USSR). J. Appl. Chem. USSR (Engl. Transl.); 46: No. 9, 2150-3(Oct 1973).
IRON-NICKEL BATTERIES;ELECTRIC CONDUCTIVITY; ANODES;PLATES;HYDROXIDES;IRON;FABRICATION; ELECTROLYTES;POWDER METALLURGY;PASSIVATION; SULFIDES;CURRENT DENSITY;TEMPERATURE DEPENDENCE; CHEMICAL COMPOSITION

4159 CREEP RESISTANCE OF LEAD CASTING ALLOYS FOR BATTERY GRIDS. Drefahl, K.; Heubner, U. (Metallgesellsch, Frankfurt am Main). Z. Metallkd.; 64: No. 10, 669-672(Oct 1973). (In German).
The creep behavior of commercial lead battery grids was determined at 20°C. For grids of lead--antimony alloys containing arsenic and copper, the 1000-h creep strength lies between 2.0 and 2.3 kg/mm², near the values of 2.4 to 2.5 kg/mm² typical for technically useful dispersion-hardened lead alloys. The creep strength increases with increasing arsenic content while, in the concentration range studied (5 to 9 wt % Sb, 0.01 to 0.05 wt % Cu), variations of the antimony and copper contents have only minor effects. The creep strength of maximum 0.8 kg/mm² of the Pb--0.07 Ca alloy studied is small and lower than many of the

values given in the literature for wrought lead--calcium alloys.

4160 THEORY OF POROUS ELECTRODES. XI. POSITIVE PLATE OF THE LEAD--ACID BATTERY. Micka, K.; Rousar, I. (Acad. Sci., Prague, Czechoslovakia). Electrochim. Acta; 18: No. 9, 629-33(Sep 1973).
LEAD-ACID BATTERIES;MASS TRANSFER; ELECTROCHEMISTRY;ELECTRODES;DIFFERENTIAL EQUATIONS;CATHODES

4161 FORMING TANK FOR LEAD--ACID BATTERY PLATES. Roach, A. (to Eltra Corp.). US Patent 3,754,994. 28 Aug 1973. Filed date 24 May 1972. 5p.
In this tank for electrical forming of plates for lead--acid batteries, plates of opposite polarity are suspended at the side of the tank. The tank is designed to accommodate plates of various sizes. (RWR)

4162 MICROPOROUS CERAMIC SEPARATOR FOR BATTERIES. Kamii, I.; Takagaki, T. (to Japan Storage Battery Co., Ltd.). Japanese Patent 1973-26,889. 17 Aug 1973. Filed date 23 May 1968. 4p.
A method for fabricating microporous ceramic separators for primary and secondary batteries and fuel cells is described. The ceramic separator is produced by quenching a molten composition of less than or equal to $^5/_3$ mole $Al_2O_3$ to 1 mole $SiO_2$ by immersing in $H_2O$, pulverizing, and baking at 950 to 1250°.

4163 STABILIZATION OF BORON PHOSPHATE SULFURIC ACID GELS. Biddick, R.E.; Ockerman, J.B. (to Dept. of the Army). US Patent 3,751,304. 7 Aug 1973. Filed date 24 Feb 1971. 3p.
A method is described in the patent for preventing the release of liquid from a sulfuric acid boron phosphate gel used in water-activated lead--acid storage batteries, and, more particularly, the addition of an excess amount of aluminum metal, magnesium or lithium aluminum hydride to this gel.

4164 HYDROGEN ENERGY STORAGE ELECTRODE. Linkohr, R. (to Deutsche Automobilgesellschaft mbH). GE 2,200,806. 26 Jul 1973. Filed date 8 Jan 1972. 10p.
ELECTRIC BATTERIES;NICKEL-HYDROGEN BATTERIES; CATHODES;HYDROGEN;FABRICATION;CHEMICAL PREPARATION;ELECTRODES

4165 DEGASSING APPARATUS FOR STORAGE BATTERIES. Retif, R. (to Soc. des Accumulateurs Fixes et de Traction). German(FRG) Patent 2,302,348. 26 Jul 1973. Filed date 19 Jan 1972. 13p.
ELECTRIC BATTERIES;ELECTROLYTES;LIQUIDS; TUBES;DESIGN;DEGASSING

4166 SEPARATOR FOR CONTROLLING ALKALI METAL ION FLOW IN AN ELECTRODE-ACTIVE MATERIAL OR ELECTROLYTE. Chiku, T.; Kamigaito, O.; Isogai, A. (to Toyota Central Research and Development Labs., Inc.). US Patent 3,743,543. 3 Jul 1973. Filed date 3 Oct 1969. 6p.
BATTERY SEPARATORS;ALUMINIUM OXIDES;SODIUM-SULFUR BATTERIES;ELECTROCHEMICAL CELLS;DESIGN

4167 CADMIUM ELECTRODES. Pickett, D.F. US Patent 375,239. 29 Jun 1973. Filed date 29 Jun 1973. 20p.
NICKEL-CADMIUM BATTERIES;ANODES;CHEMICAL PREPARATION

4168 IC TIMER AUTOMATICALLY MONITORS BATTERY VOLTAGE. McGowan, E.J. Jr. (Stoelting Co., Chicago, Il). Electronics; 46: No. 13, 130-1(21 Jun 1973).
Keeps full charge on standby battery. ELECTRIC BATTERIES;ELECTRIC POTENTIAL; INTEGRATED CIRCUITS;MONITORING;BATTERY CHARGING; JUNCTION DIODES;BATTERY CHARGERS;DESIGN

4169 ALLOYS FOR ELECTRODE GRIDS FOR LEAD--ACID BATTERIES. Sims, R.I. (to Lucas, Joseph, (Batteries) Ltd.). German(FRG) Patent 2,260,355. 20 Jun 1973. Filed date 15 Dec 1971. 9p.
Patet. LEAD-ACID BATTERIES;GRIDS;LEAD BASE ALLOYS;CALCIUM ADDITIONS;ALUMINIUM ADDITIONS; FABRICATION

4170 PROTECTIVE COATINGS ON POSITIVE NICKEL ELECTRODES. Bauer, M.; Ewe, H.; Justi, E. (to Varta AG). German(FRG) Patent 2,161,898. 20 Jun 1973. Filed date 14 Dec 1971. 11p.
Carbonyl-Ni electrode supports in batteries, fuel cells, and electrolytic cells with alkaline electrolytes were considered. $Ni(OH)_2$ formation on the support was prevented by heating in air (or oxygen) at 200 to 350°; a protective layer of NiO was thus formed. Electrolyte-flow resistance was greatly improved. (RWR)

4171 CELL OR BATTERY HOUSING OF SYNTHETIC RESIN FOR MAINTENANCE-FREE BATTERIES. Von Roda, E.; Trankle, E. (to Bosch, Robert, GmbH). US Patent 3,738,860. 12 Jun 1973. Filed date 26 May 1970. 5p.
LEAD-ACID BATTERIES;ELECTRIC BATTERIES; RESINS;POLYSTYRENE;POLYPROPYLENE;CONTAINERS; SHELLS;PERFORMANCE

4172 HYDROGEN STORAGE ELECTRODE. Linkohr, R.; Holz, R.; Plust, H.G. (to Deutsche Automobilgesellschaft mbH). GE 2,160,202. 7 Jun 1973. Filed date 4 Dec 1971. 10p.
NICKEL-HYDROGEN BATTERIES;METAL-GAS BATTERIES;ELECTRODES;FABRICATION

4173 NEGATIVE ELECTRODE PLATE FOR LEAD STORAGE BATTERIES. Yamamoto, S.; Aizawa, K. (to Furukawa Battery Co., Ltd.). Japanese Patent 37,643. 2 Jun 1973. Filed date 15 Sep 1971. 3p.
Patent; lignin and PVA additives extend battery lifetime. LEAD-ACID BATTERIES;ANODES; PLATES;PVA;LIGNIN;LIFETIME;FABRICATION;LEAD OXIDES;TESTING

4174 PROPERTIES OF LICL AND $(CH_3)_4NCL$ SOLUTIONS IN WATER--METHANOL MIXTURES. Miles, M.H.; Jiamsakul, V. (Middle Tennessee State Univ., Murfreesboro). J. Electrochem. Soc.; 120: No. 6, 709-12(Jun 1973).
LITHIUM CHLORIDES;METHANOL;AQUEOUS SOLUTIONS; VISCOSITY;ELECTRIC CONDUCTIVITY;SURFACE TENSION; QUATERNARY COMPOUNDS;CHLORIDES;ALCOHOL FUEL CELLS;ELECTRIC BATTERIES;SOLVENTS;ELECTROLYTES

4175 RUGGED SILVER--SILVER CHLORIDE ELECTRODE FOR FIELD USE. Corwin, R.F.; Conti, U. (Marine Minerals Technol. Cent., Tiburon, CA). Rev. Sci. Instrum.; 44: No. 6, 708-11(Jun 1973).

2.7 M KCl filling solution saturated with AgCl. ELECTRODES;SILVER;SILVER CHLORIDES; POTASSIUM CHLORIDES;ELECTRIC BATTERIES

4176 ZINC/AIR OR ZINC/OXYGEN CELLS. Uchida, S.; Kumano, S. (to Hitachi Maxwell, Ltd.). British Patent 1,317,214. 16 May 1973. Filed date 12 Aug 1970. 5p.
Patent; improved aging by enclosing cathode in sheath. ZINC-AIR BATTERIES;CATHODES;PRESSURE DEPENDENCE;FABRICATION

4177 CATHODIC POLARIZATION CHARACTERISTICS OF POLY(4-VINYLPYRIDINE) BROMINE COMPLEX. Saito, T.; Ikeda, H.; Matsuda, Y.; Tamura, H. (Osaka Univ., Japan). J. Appl. Electrochem.; 3: No. 2, 99-102(May 1973).
ELECTRIC BATTERIES;ELECTRODES;GRAPHITE; CARBONIC ACID ESTERS;LITHIUM BROMIDES;ELECTRIC POTENTIAL;EFFICIENCY;POLYVINYLS;PYRIDINES; ORGANIC BROMINE COMPOUNDS;POLARIZATION

4178 EVALUATION OF POROUS ELECTRODES THROUGH CELL POWER MAXIMUM MEASUREMENTS. Szpak, S.; McWilliams, G.E. (Mare Island Naval Shipyard, Vallejo, CA). J. Electrochem. Soc.; 120: No. 5, 635-9(May 1973).
ELECTRIC BATTERIES;ELECTRODES;PERFORMANCE TESTING;POROSITY;POWER;TIME DEPENDENCE

4179 BEHAVIOR OF THE SILVER/SILVER CHLORIDE ELECTRODE IN CONCENTRATED AQUEOUS SODIUM CHLORIDES. Gibbard, H.F. Jr. (Southern Illinois Univ., Carbondale). J. Electrochem. Soc.; 120: No. 5, 624-627(May 1973).
The reported solute and solvent activities of concentrated aqueous sodium chloride are not thermodynamically consistent within the apparent experimental errors. This result is attributed to a deviation of the silver, silver chloride electrode owing to the formation of a solid solution of silver chloride and sodium chloride. Electrochemical cell measurements and x-ray diffraction results are reported in support of these conclusions. The mole fractions and activities of silver chloride in the solid solutions are calculated from solubility equilibria and are correlated with literature values of the activity coefficients of sodium chloride.

4180 PREPARATION OF AN ALKALINE IRON ELECTRODE MATERIAL USING SULFUR ACIDS. Jackovitz, J.F.; Pantier, E.A. (to Westinghouse Electric Corp.). US Patent 3,947,292. 18 Apr 1973. Filed date 18 Feb 1971. vp.
An activated iron electrode material suitable for use in a battery electrode plate is described. It consists essentially of (1) iron particles consisting essentially of substantially pure iron oxides selected from the group consisting of FeO, $Fe_3O_4$, $Fe_2O_3.H_2O$ and mixtures thereof and (2) the chemical reaction product of an iron particle component consisting essentially of substantially pure iron oxides selected from the group consisting of FeO, $Fe_2O_3$, $Fe_2O_3$, $Fe_3O_4$, $Fe_2O_3.H_2O$ and mixtures thereof and at least one sulfur-substituted organic acid selected from the group consisting of thiolic, dithiolic, and mercapto-carboxylic acids, the mixture containing about 0.01 to 2 weight percent total sulfur. The plaque can be between 75 and 95 percent porous and the iron particle component can be selected from the group consisting of FeO, $Fe_2O_3$, $Fe_3O_4$, $Fe_2O_3.H_2O$ and mixtures thereof.

4181 ONE LAMP CAN MONITOR BATTERY VOLTAGE. Thai, N.D. (Huntec. Ltd., Toronto, Ontario). Electronics; 46: No. 8, 106(12 Apr 1973).
ELECTRIC BATTERIES;ELECTRIC POTENTIAL; MONITORING;POWER SUPPLIES;ELECTRONIC CIRCUITS

4182 SEMICONDUCTING CATHODE FOR STORAGE BATTERIES. (to Molecular Energy Corp.). French Patent 2,146,169. 6 Apr 1973. Filed date 22 Jul 1971. 8p.
CATHODES;SEMICONDUCTOR MATERIALS;SULFIDES; HALIDES;OXIDES;METAL-NONMETAL BATTERIES; FABRICATION

4183 HEAT RESISTANT SUBSTRATES AND A BATTERY SEPARATOR MADE THEREFROM. Langer, A.; Scala, L.C.; Ruffing, C.R. (to Westinghouse Electric Corp.). US Patent 3,953,241. 26 Mar 1973. Filed date 12 Mar 1970. vp.
A flexible porous substrate comprises a caustic resistant porous flexible support. At least one side of the support is in contact with and attached to a membrane consisting essentially of a caustic resistant solid polymeric matrix containing a network of a plurality of interconnected pores having diameters between about 5 and 75 microns, and interdispersed caustic resistant inorganic filler particles having a particle size diameter of between about 74 to 700 microns. The weight ratio of filler:polymer in the polymeric matrix ranges from 1:1 to 5:1, so that are a large number of filler particle contact points in the polymeric matrix.

4184 REACTION CATALYST FOR THE ELIMINATION OF OXYHYDROGEN GAS IN LEAD--ACID STORAGE BATTERIES. Lahme, N.; Sassmannshausen, G. (to Accumulatorenwerk Hoppecke). US Patent 3,940,348. 15 Mar 1973. Priority date 18 Mar 1972, German, Federal Republic of (F.R. Germany). vp.
A unitary catalyst element for catalytically recombining into water a gas mixture of oxygen and hydrogen formed during operation of lead--acid storage battery is described. It comprises a single elongated catalyst carrier body in the form of a permeable coherent solid, an active metallic catalyst material of the platinum group carried on the surface of the permeable catalyst carrier body, and an axially disposed core member of highly heat conductive material enclosed within said catalyst carrier body.

4185 C-MOS VOLTAGE MONITOR PROTECTS NI--CD BATTERIES. Wilke, W. (Univ. of Wisconsin, Madison). Electronics; 46: No. 5, 85-6(1 Mar 1973).
NICKEL-CADMIUM BATTERIES;ELECTRIC POTENTIAL; MONITORING;SAFETY;OPERATION;MOS TRANSISTORS

4186 MEASUREMENT OF ZINCATE PERMEATION IN A POLYETHYLENE BATTERY SEPARATOR WITH CONTROLLED EXTERNAL HYDRODYNAMIC CONDITIONS. Litt, M.; Nanis, L.; Chen, J.L.P. (Univ. of Pennsylvania, Philadelphia). J. Electrochem. Soc.; 120: No. 3, 324-8(Mar 1973).
ZINCATES;BATTERY SEPARATORS;POLYETHYLENES; SPACE VEHICLES;SPACECRAFT POWER SUPPLIES; MEMBRANES;SILVER-ZINC BATTERIES;MEDIUM TEMPERATURE;POTASSIUM HYDROXIDES;ACTIVATION ENERGY;ACRYLIC ACID;AROMATICS;GRAFT POLYMERS; CROSS-LINKING

4187 EXTRACTION OF BATTERY-GRADE MANGANESE DIOXIDE FROM LOW-GRADE MANGANESE ORES. Yousef, A.A.; Arafa, M.A.; Boulos, T.R.

Aufbereit.-Tech.; 14: No. 3, 162-5(Mar 1973). (In German).
ZINC-MANGANESE BATTERIES;CATHODES;MANGANESE OXIDES;MANGANESE ORES;LEACHING;FABRICATION; SULFUR OXIDES;AIR;SATURATION;AQUEOUS SOLUTIONS; CHEMICAL PREPARATION

4188 PREPARATION OF VACUUM-DEPOSITED FILMS ON RUBIDIUM SILVER IODIDE. Kennedy, J.H.; Chen, F.; Hunter, J. (Univ. of California, Santa Barbara). J. Electrochem. Soc.; 120: No. 3, 454-458(Mar 1973).
Vacuum-deposited thin films of $RbAg_4I_5$ were prepared exhibiting conductivities of 0.25 $(ohm-cm)^{-1}$ at 25 C and an activation energy of 2.3 kcal/mole. The purest films of $RbAg_4I_5$ were produced when the evaporation source composition was 83 to 85 mole per cent (m/o) AgI. Electrolytic cells of the type Ag/$RbAg_4I_5$/Au were prepared and were studied by cyclic voltammetry with a silver reference electrode and as coulometers. Cells could be cycled electrochemically over 1000 times, but coalescence of $RbAg_4I_5$ films eventually led to loss of electrode contact. Degradation was accelerated when the cells were exposed to humid air.

4189 SINTERED ALUMINA WITH GOOD ION PERMEABILITY PROPERTIES. (to Toyota Central Research and Development Labs., Inc.). French Patent 2,139,677. 16 Feb 1973. Filed date 28 May 1971. 16p.
SODIUM-SULFUR BATTERIES;BATTERY SEPARATORS; FABRICATION;ALUMINIUM OXIDES;SINTERED MATERIALS; CHEMICAL PREPARATION

4190 LITHIUM BATTERY ELECTROLYTE ADDITIVE AND METHOD OF IMPROVING DISCHARGE RATE. Butler, J.N.; Cogley, D.R. (to Dept. of Air Force). US Patent 3,716,410. 13 Feb 1973. Filed date 27 Sep 1971. 5p.
A method is described for improving the discharge rate of lithium batteries by adding a small amount of a hexamethyl phosphoramide additive to the lithium perchlorate--propylene carbonate electrolyte of the battery.

4191 CATHODES FOR SECONDARY ELECTROCHEMICAL POWER-PRODUCING CELLS. Cairns, E.J.; Kyle, M.; Shimotake, H. (to Atomic Energy Commission). US Patent 3,716,409. 13 Feb 1973. Filed date 8 Sep 1971. 12p.
A secondary electrochemical power-producing cell includes an anode containing lithium, an electrolyte containing lithium ions, and a cathode containing sulfur. The cathode comprises plates of a porous substrate material impregnated with sulfur alternating with layers (which may also comprise porous substrate plates) containing electrolyte.

4192 CURRENT DISTRIBUTION IN THE POROUS LEAD DIOXIDE ELECTRODE. Simonsson, D. (Royal Inst. of Technol., Stockholm, Sweden). J. Electrochem. Soc.; 120: No. 2, 151-7(Feb 1973).
CATHODES;LEAD-ACID BATTERIES;ELECTRIC CURRENTS;DISTRIBUTION;PLATES;PASSIVATION

4193 ZINC ELECTRODES FOR RECHARGEABLE ZINC/AIR CELLS. Dietz, H. (Robert Bosch, Stuttgart, Germany). Chem.-Ing.-Tech.; 45: No. 4, 197-200(Feb 1973). (In German).
ANODES;ZINC-AIR BATTERIES;ELECTRIC-POWERED VEHICLES;POTASSIUM CARBONATES;PERFORMANCE; HYDROGEN;GASES;EMISSION;LIFETIME

4194 EFFECTS OF MERCURY ON THE SURFACES OF POLYCRYSTALLINE COPPER, TIN AND ZINC. Barnard, R. (Ever Ready Co., London, England). J. Appl. Electrochem.; 3: No. 1, 17-22(Feb 1973).
ELECTRIC BATTERIES;ELECTRODES;TIN;ZINC; COPPER;POLYCRYSTALS;MERCURY;SURFACES;POTASSIUM HYDROXIDES;HYDROGEN;CHEMICAL REACTIONS

4195 IRON ELECTRODES FOR METAL/AIR CELLS. Cnobloch, H.; Groeppel, D.; Nippe, W.; von Sturm, F. (Siemens, Erlangen, Germany). Chem.-Ing.-Tech.; 45: No. 4, 203-6(Feb 1973). (In German).
IRON;METAL-GAS BATTERIES;AIR;CURRENT DENSITY; MEDIUM TEMPERATURE;ANODES;PERFORMANCE

4196 ELECTROCHEMICAL APPLICATION OF AMALGAMATED-NICKEL BODIES. Jung, M. (VARTA, Kelkheim, Germany). Chem.-Ing.-Tech.; 45: No. 4, 210-13(Feb 1973). (In German).
CHEMICAL PREPARATION;NICKEL ALLOYS;MERCURY BASE ALLOYS;ELECTRIC BATTERIES;CATHODES; HYDROXIDES;MERCURY OXIDES;METAL-GAS BATTERIES; AIR;ANODES;ELECTRODES;SINTERED MATERIALS; CARBONYLS;HYDRAZINE FUEL CELLS;ELECTRODES

4197 METHOD OF MAKING A URANIUM CONTAINING CATALYST FOR A METAL ELECTRODE. Fukuda, M.; Miura, T.; Takahashi, K. (to Matsushita Electric Industrial Co.). US Patent 3,709,834. 9 Jan 1973.
CATALYSTS;ELECTRIC BATTERIES;ELECTRICAL PROPERTIES;ELECTROCHEMISTRY;ELECTRODES;FUEL CELLS;URANIUM

4198 MORPHOLOGY AND CAPACITY OF A CADMIUM ELECTRODE. Will, F.G.; Hess, H.J. (GE, Schenectady, NY). J. Electrochem. Soc.; 120: No. 1, 1-11(Jan 1973).
ELECTROCHEMISTRY;MORPHOLOGICAL CHANGES; PLATES;POROSITY;SIMULATION;MICROSCOPY; PASSIVATION;PARTICLE SIZE;PRECIPITATION; ELECTRODEPOSITION;ELECTRIC BATTERIES;ELECTRODES; CADMIUM;NICKEL-CADMIUM BATTERIES;SILVER-CADMIUM BATTERIES;ANODES

4199 RECENT RESULTS ON LEAD--CALCIUM ALLOYS AS GRID MATERIALS FOR LEAD--ACID BATTERIES. Mao, G.W.; Larson, J.G.; Rao, P. (Gould Inc., Mendota Heights, MN). J. Electrochem. Soc.; 120: No. 1, 11-17(Jan 1973).
Gravity and pressure casting. LEAD BASE ALLOYS;CALCIUM ADDITIONS;GRIDS;LEAD-ACID BATTERIES;CORROSION;MORPHOLOGICAL CHANGES; SOLIDIFICATION;CASTING

4200 USE OF HUMIC ACIDS IN STORAGE BATTERIES. Varga, E. Magy. Kem. Lapja; 28: No. 6, 272-7(1973).
LEAD-ACID BATTERIES;HUMIC ACIDS;CHEMICAL PREPARATION;CATHODES;PERFORMANCE

4201 NEW TYPE OF REVERSIBLE NEGATIVE ELECTRODE FOR ALKALINE STORAGE BATTERIES BASED ON METAL ALLOY HYDRIDES. Gutjahr, M.A.; Buchner, H.; Beccu, K.D. (Battelle, Geneva, Switzerland); Saeufferer, H. (Daimler-Benz AG, Stuttgart, W. Germany). pp 79-91 of Power sources 4: Research and development in non-mechanical electrical power sources; Proceedings of the Eighth International Symposium, Brighton, Sussex, England, September 24-26, 1972. Collins, D.H. (ed.). Newcastle-upon-Tyne, England; Oriel Press, Ltd. (1973).

From 8. International Symposium; Brighton, Sussex, England (24-26 Sep 1972).
ELECTRIC BATTERIES;ELECTRODES;ALLOYS; HYDRIDES

4202 FUNCTIONAL ASPECTS OF SEPARATORS FOR SILVER--ZINC ALKALINE STORAGE BATTERIES. Adams, L.B.; Fydelor, P.J.; Partridge, G.; West, R.H. (Royal Military College of Science, Swindon, Wilts., England). pp 141-62 of Power sources 4: Research and development in non-mechanical electrical power sources; Proceedings of the Eighth International Symposium, Brighton, Sussex, England, September 24-26, 1972. Collins, D.H. (ed.). Newcastle-upon-Tyne, England; Oriel Press, Ltd. (1973).
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Graft copolymer separators prepared by radiation-initiated grafting of carboxylic acids. SILVER-ZINC BATTERIES;BATTERY SEPARATORS; GRAFT POLYMERS;COPOLYMERIZATION;CHEMICAL RADIATION EFFECTS;CARBOXYLIC ACIDS;CHEMICAL PROPERTIES;COMPARATIVE EVALUATIONS;PERFORMANCE

4203 EFFECTS OF KOH CONCENTRATION ON MORPHOLOGY AND ELECTRICAL CHARACTERISTICS OF SINTERED SILVER ELECTRODES. Wales, C.P. (US Navy, Naval Research Lab., Washington, DC). pp 163-83 of Power sources 4: Research and development in non-mechanical electrical power sources; Proceedings of the Eighth International Symposium, Brighton, Sussex, England, September 24-26, 1972. Collins, D.H. (ed.). Newcastle-upon-Tyne, England; Oriel Press, Ltd. (1973).
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SILVER-ZINC BATTERIES;SILVER;ELECTRODES; MORPHOLOGICAL CHANGES;ELECTRICAL PROPERTIES; POTASSIUM HYDROXIDES;SINTERED MATERIALS

4204 BEHAVIOR OF SINTERED PLATE NICKEL HYDROXIDE ELECTRODES IN LITHIATED ELECTROLYTE SOLUTIONS. Kelson, P.; Sperrin, A.D.; Tye, F.L. (Ever Ready Co., (Great Britain), Ltd., England). pp 201-21 of Power sources 4: Research and development in non-mechanical electrical power sources; Proceedings of the Eighth International Symposium, Brighton, Sussex, England, September 24-26, 1972. Collins, D.H. (ed.). Newcastle-upon-Tyne, England; Oriel Press, Ltd. (1973).
From 8. International Symposium; Brighton, Sussex, England (24-26 Sep 1972).
NICKEL-ZINC BATTERIES;NICKEL HYDROXIDES; ELECTRODES;ELECTROLYTES;LITHIUM HYDROXIDES; MEDIUM TEMPERATURE;TEMPERATURE DEPENDENCE; CHEMICAL REACTION KINETICS;ELECTRIC BATTERIES

4205 HYBRID OXYGEN ELECTRODE FOR METAL--AIR BATTERIES. Cnobloch, H.; Siemsen, G.; Sturm, F.v. (Siemens AG, Erlangen, West Germany). pp 311-25 of Power sources 4: Research and development in non-mechanical electrical power sources; Proceedings of the Eighth International Symposium, Brighton, Sussex, England, September 24-26, 1972. Collins, D.H. (ed.). Newcastle-upon-Tyne, England; Oriel Press, Ltd. (1973).
From 8. International Symposium; Brighton, Sussex, England (24-26 Sep 1972).
METAL-GAS BATTERIES;ELECTRODES;OXYGEN;NICKEL; CARBON

4206 INVESTIGATION OF ACTIVE CARBON FOR USE IN FUEL CELL AIR ELECTRODE OR METAL-AIR SYSTEMS. Vorkapic, L.; Drazic, D. (Inst. za hemiju technologiju i metalurgiju, Beograd). Tehnika hemijska industrija; 27: No. 9, 206-10(1973).
ACTIVATED CARBON;FUEL CELLS;METAL-GAS BATTERIES;CATHODES;POLARIZATION

4207 CHLORINE ELECTRODES IN THE ZINC--CHLORINE BATTERY SYSTEM. Symons, P.C.; Carr, P. (Oxy Energy Development Lab., Madison Heights, MI). pp 72-77 of 8th intersociety energy conversion engineering conference proceedings. New York; American Inst. of Aeronautics and Astronautics (1973).
From 8. intersociety energy conversion engineering conference; Philadelphia, PA (13 Aug 1973).
Up to 60 kW-hr. ZINC-CHLORINE BATTERIES; ELECTRODES;GRAPHITE;ELECTROLYTES;POLARIZATION; LIFETIME;AUTOMOBILES;ELECTRIC-POWERED VEHICLES

4208 CHLORINE ELECTRODES IN THE ZINC--CHLORINE BATTERY SYSTEM. Symons, P.C.; Carr, P. (Oxy. Energy Dev. Lab., Madison Heights, MI). pp 72-7 of 8th Intersociety Energy Conversion Engineering Conference Proceedings, Pt. I. Philadelphia, PA, 13-16 Aug 1973. New York; AIAA (1973).
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50 V, 1 kWh. ZINC-CHLORINE BATTERIES; CATHODES;CHLORINE;HYDRATES;GRAPHITE;CARBON; PERFORMANCE;POLARIZATION;ELECTROLYTES;CORROSION; LIFETIME

4209 CHOICE OF AN EDDY CURRENT TRANSFORMER FOR MONITORING THE QUALITY OF THE NICKEL CERMET ELECTRODE BASES OF A LOW-VOLTAGE CABLE STORAGE BATTERY. Bogdanov, V.I. Tr. Novocherkassk. Politekh. Inst.; 285: 74-7(1973).
ELECTRIC BATTERIES;ELECTRODES;SINTERED MATERIALS;FABRICATION;NICKEL COMPOUNDS; CARBONYLS;QUALITY CONTROL

4210 USE OF CATHODE ANTIMONY FOR A STANDARD BATTERY ALLOY. Baiborodov, P.P.; Ezhkov, A.B.; Kurkchi, U.M.; Kolobin, N.A.; Mikhailova, G.M. Nauch. tr. Sredneaz. n. i. i proekt. in-t tsvet. metallurgii; No. 8, 3-7(1973).
LEAD-ACID BATTERIES;CATHODES;ANTIMONY; ANTIMONY ALLOYS;LEAD

4211 SELECTION OF MATERIAL AND METHOD OF JOINING IN THE PRODUCTION OF INSULATORS FOR AN ALKALINE STORAGE BATTERY. Kazakov, V.N.; Kharitonov, S.D. 5: 135-8(1973).
ELECTRIC BATTERIES;DIELECTRIC MATERIALS; ALUMINIUM OXIDES;CERAMICS;SILICON OXIDES; CALCIUM OXIDES;LIFETIME;JOINING

4212 REGULATED DC THYRISTOR CONVERTER AS A SERIAL COMPENSATOR OF BATTERY VOLTAGE. Polzelnik, L. (Zavod za Avtomatizaciju, Ljubljana). Elektroteh. Vestn.; 40: No. 3-5, 117-20(1973).
ELECTRIC BATTERIES;POWER SUPPLIES;ELECTRIC POTENTIAL;VARIATIONS;VOLTAGE REGULATORS;DIRECT CURRENT;THYRISTORS

4213 SELF-DISCHARGE OF NICKEL OXIDE ELECTRODES. Omel'chenko, V.Ya.; Kul'min, L.L. Tr. Ivanov. Khim.-Tekhno. In-Ta; 16: 103-8(1973).
IRON-NICKEL BATTERIES;NICKEL-CADMIUM BATTERIES;NICKEL-ZINC BATTERIES;CATHODES; ELECTRIC BATTERIES;ELECTRODES;NICKEL OXIDES

4214 PREPARATION OF HIGHLY CONDUCTIVE BETA-ALUMINA AND ELECTROCHEMICAL MEASUREMENTS. Kennedy, J.H.; Sammells, A.F. (Univ. of California, Santa Barbara). pp 463-572 of Fast ion transport solids, solid state batteries devices. Van Gool, (ed.). Amsterdam; North-Holland Publishing Co. (1973).
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4215 (AD--785970) SEMICONDUCTING CHARGE--DISCHARGE DEVICES FOR STORAGE BATTERIES. Volotkovskii, S.A.; Fursov, V.D; Sidorenko, E.I. Translated from Mekh. Avtom. Proizvod.; No. 2, 14-16(1973). 11p. NTIS $3.25.
MINES;ELECTRIC BATTERIES;SEMICONDUCTOR DEVICES;BATTERY CHARGERS;CONTROL SYSTEMS; ELECTRIC-POWERED VEHICLES;DESIGN;ELECTRONIC CIRCUITS

4216 PERMSELECTIVE BATTERY SEPARATOR MEMBRANES. Rogers, C.E.; Ostler, M.I. (Case Western Reserve Univ., Cleveland). Polym. Prepr., Am. Chem. Soc., Div. Polym. Chem.; 14: No. 1, 587-590(1973).
Ethylene--potassium acrylate--styrene graft copolymer, irradiation grafting. BATTERY SEPARATORS;MEMBRANES;GRAFT POLYMERS;STYRENE; ETHYLENE;ACRYLATES;POTASSIUM COMPOUNDS; COPOLYMERIZATION;CHEMICAL RADIATION EFFECTS; PERFORMANCE;MASS TRANSFER;SILVER COMPOUNDS; SALTS;FABRICATION

4217 NEW ELECTRODE MATERIAL. Armand, M.B. (Ec. Natl. Super Electrochim., St. Martin d'Heres, Fr.). pp 665-73 of Fast ion transp. solids, solid state batteries devices, Proceedings NATO Adv. Study Inst., 1972. Van Gool, W. (ed.). Amsterdam, Netherlands; North-Holland Publishing Co. (1973).
M/sub x/(graphite-CrO/sub n/) where M is K, Na, or L, Na/β-alumina/$CaCrO_3$ produced 3.9 V, storage capacity of 1.1 kWh/kg. CATHODES;METAL-NONMETAL BATTERIES;GRAPHITE;POTASSIUM COMPOUNDS; SODIUM COMPOUNDS;LITHIUM COMPOUNDS;CHROMIUM OXIDES;INTERSTITIALS;SOLIDS;ELECTRODES

4218 USE OF AN ANTIMONY CATHODE FOR PRODUCTION OF A UNIFIED STORAGE BATTERY ALLOY. Baiborodov, P.P.; Ezhkov, A.B.; Kurkchi, U.M.; Kolbin, N.A.; Mikhailova, G.M. Sb. Nauchn. Tr. - Sredneaziat. Nauchno-Issled. Proektn. Inst. Tsvetn. Metall.; 8: 3-7(1973).
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4219 BILATERAL POWER CONDITIONER. Cardwell, G.I.; Neel, W.O. III. (Hughes Aircr. Co., El Segundo, CA). pp 214-21 of Proceedings of IEEE power electron special conference, California Inst. of Technology, Pasadena, 11-13 Jun 1973. New York; IEEE (1973).
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SATELLITES;ELECTRIC BATTERIES;BATTERY CHARGERS;OPERATION;POWER CONDITIONING CIRCUITS; PERFORMANCE

4220 SOLID ELECTROLYTES. Swinkels, D.A.J. (Central Research Lab., Shortland, Australia). Proc. R. Aust. Chem. Inst.; 40: No. 10, 281-287(1973).
A review on solid electrolytes and their application in fuel cells and electric batteries is presented. (67 references.)

4221 INFLUENCE OF THE STRUCTURE OF SILVER-ACTIVATED GAS ELECTRODES ON THE ELECTROCHEMICAL PERFORMANCE OF FUEL CELLS AND METAL--AIR CELLS. Radovici, O.; Mavrodin-Tarabic, M.; Onaca, I.; Solacolu, I. (Centrul de Chimie Fizica, Bucharest). Electrotehnica (Bucharest); 20: No. 10, 383-389(1973). (In Rumanian).
Pore size effects. FUEL CELLS;SILVER; CATALYSTS;ELECTRODES;POROSITY;ELECTRIC POTENTIAL;PERFORMANCE;METAL-GAS BATTERIES

4222 ACTIVE CARBONS FOR USE IN FUEL CELL AIR ELECTRODES OR METAL--AIR SYSTEMS. Vorkapic, L.; Drazid, D. (Inst. of Metallurgy, Belgrade). Hem. Ind.; 27: No. 9, 383-387(1973). (In Serbo-Croatian).
The performance of activated carbon electrodes in fuel cells was studied. Polarization curves were measured and $H_2O_2$ decomposition was used to test the carbon materials. Both powder and pressed electrodes were tested and results are discussed.

4223 CARBON--AIR ELECTRODE FOR METAL--AIR BATTERIES AND FUEL CELLS. Drazic, D.M.; Vorkapic, L.Z.; Adzic, R.R. (Belgrade Univ.). Bull. Soc. Chim. Beogr.; 38: No. 5-6, 375-381(1973).
A method for fabricating air cathodes for fuel cells or zinc--air batteries is described. A layer of activated carbon powder and a layer of polyethylene powder are pressed on a nickel plated iron screen. The carbon powder is impregnated with 30 mg $Ag/cm^2$.

4224 COMPOSITE NICKEL POWDER FOR PREPARING PLAQUES FOR NICKEL CADMIUM BATTERIES. Prema, R.; Rao, P.V.; Vasudeva; Udupa, H.V.K. (Central Electrochemical Research Inst., Karaikudi, India). J. Electrochem. Soc. India; 22: No. 4, 303-306(1973).
A process for producing composite Ni powder for Ni/Cd battery plates and fuel cell electrodes is described. Core materials (e.g. $TiO_2$) are coated at high temperature to prepare an oxide-coated core, which is reduced to obtain the composite powder. Chemical and polarization characteristics of the result are discussed. (RWR)

4225 CONDUCTIVITY OF BETA-ALUMINA AND ITS DEPENDENCE ON SODIUM AND MAGNESIUM CONTENT. Kennedy, J.H.; Sammells, A.F. (Univ. of Calif., Santa Barbara). J. Electrochem. Soc.; 119: No. 12, 1609-13(Dec 1972).
ELECTRIC BATTERIES;SODIUM-SULFUR BATTERIES; ELECTROLYTES;ELECTROCHEMISTRY;IONIC CONDUCTIVITY;ALUMINIUM OXIDES;MAGNESIUM OXIDES; QUANTITY RATIO;SINTERED MATERIALS;SODIUM OXIDES

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4227 INDUSTRIAL BATTERY CHARGER FOR MOBILE EQUIPMENT USE. Brugger, C. (Motorola Semiconductors Ltd.). Control Instrum.; 4: No. 9, 45-7(Oct 1972).
20 A. BATTERY CHARGERS;DESIGN;LEAD-ACID

BATTERIES;AMPLIFIERS;INTEGRATED CIRCUITS

4228 SIMPLE REGULATED POWER SUPPLIES FOR BATTERY OPERATED EQUIPMENT. Riordan, R.H.S. (CSIRO, Highett, Victoria, Australia). Proc. Inst. Radio Electron. Eng. Aust.; 33: No. 10, 480-8(Oct 1972).
DC TO DC CONVERTERS;ELECTRIC BATTERIES; VOLTAGE REGULATORS;OPERATION;ELECTRIC POTENTIAL; ELECTRONIC CIRCUITS;DESIGN;RADIO EQUIPMENT POWER SUPPLIES;MEASURING INSTRUMENTS

4229 ION EXCHANGER MEMBRANES AS SEPARATORS IN ALKALINE ZINC--AIR BATTERIES. Wolf, F.; Pollandt, P. (Univ. Halle, E. Germany). Plaste Kaut.; 19: No. 8, 576-9(Aug 1972). (In German).
ION EXCHANGE MATERIALS;MEMBRANES;BATTERY SEPARATORS;ZINC-AIR BATTERIES;POLYSTYRENE; POLYMERS;COPOLYMERIZATION;HYDROXIDES

4230 VOLTAMMETRIC INVESTIGATIONS OF NEGATIVE LEAD BATTERY ELECTRODES: THE EFFECT OF ORGANIC EXPANDERS. Niklas, H.; Jakobljevich, H. (Forschungs- und Entwicklungszentrum, Kelkheim/Ts, Germany). J. Appl. Electrochem.; 2: No. 3, 165-7(Aug 1972).
Formation process of Pb sheets in $H_2SO_4$. ANODES;LEAD-ACID BATTERIES;ELECTROCHEMISTRY; FABRICATION;LEAD;SHEETS;SULFURIC ACID;ORGANIC COMPOUNDS;ADDITIVES

4231 EVALUATION OF ORGANIC BATTERY ELECTRODES: VOLTAMMETRIC STUDY OF THE REDOX BEHAVIOR OF SOLID QUINONES. Alt, H.; Binder, H.; Klempert, G.; Koehling, A.; Sandstede, G. (Battelle-Inst., Frankfurt am Main, Germany). J. Appl. Electrochem.; 2: No. 3, 193-200(Aug 1972).
REDOX REACTIONS;QUINONES;SULFURIC ACID; AMMONIUM COMPOUNDS;CHLORIDES;CHLORANIL;PH VALUE; ELECTRIC BATTERIES;CATHODES;REDOX POTENTIAL

4232 CERAMIC SEPARATORS FOR A HIGH TEMPERATURE LITHIUM BATTERY. Fishwick, J.H.; Yeh, W.C.T. (Foote Mineral Co., Exton, PA). Am. Ceram. Soc. Bull.; 51: No. 8, 633-636(Aug 1972).
Seven materials based on the cations Li and Ca, and aluminate and zirconate anions, were tested for their ability to withstand the attack of molten lithium and fused LiCl--KCl eutectic at 580°C. $CaZrO_3$ exhibited the highest resistance. $CaZrO_3$ is recommended for consideration as a separator material in a lithium battery operating up to 580°C.

4233 LEAD SULFATE DISTRIBUTION IN DISCHARGED NEGATIVE ELECTRODE PLATES OF LEAD BATTERIES. Panesar, H.S.; Portscher, V. (VARTA Forschungs- und Entwicklungszentrum, Kelkheim, Ger.). Metalloberflaeche; 26: No. 7, 252-253(Jul 1972). (In German).
Three $PbSO_4$ profiles are plotted and discussed; one shows $PbSO_4$ distribution in totally discharged negative electrode plates as a function of discharge density (1.5 to 180 mA/cm²). Two show $PbSO_4$ distribution as a function of the state of discharge (25 to 100%) for discharge densities of 30 and 180 mA/cm², respectively.

4234 EFFECT OF GRID CAST STRUCTURE ON THE ANODIC CORROSION OF LEAD. Feliu, S.; Galan, L.; Gonzalez, J.A. Werkst. Korros.; 23: No. 7, 554-561(Jul 1972).
Unalloyed lead, Pb--0.09Ca, Pb--0.46Ag, Pb--6Sb, Pb--11.6Sb, and Pb--6Sb--0.2Ag--0.2As--0.5Sn were subjected to anodic corrosion in $H_2SO_4$ at current densities of 0.84 and 0.14 mA/cm². Specimens varied in grain size. Weight losses were determined and correlated with results of microscopic examinations. Grain size did affect corrosion, but the effect depended on composition. An explanation is suggested in terms of selective attack of the material and disintegration of structural units.

4235 REMOVAL OF SURFACE ANTIMONY FROM ANTIMONY LEAD ALLOYS BY SULFURIC ACID--HYDROGEN PEROXIDE PICKLING. Crompton, T.R.; Uitenbroek, G. (Oldham and Son Ltd., Manchester, Eng.). J. Electrochem. Soc.; 119: No. 6, 655-660(Jun 1972).
It is shown that treatment of cast antimonial lead alloys with mixtures of hydrogen peroxide and sulfuric acid at 20°C dissolves surface antimony at an appreciably greater rate than occurs with sulfuric acid alone, even at elevated temperatures. Optimum hydrogen peroxide--sulfuric acid reagent compositions were established for the maximum solution of antimony from the alloy. A correlation exists between the quantity of antimony removed by this treatment and the quantity of antimony that is subsequently released from the alloy into sulfuric acid electrolyte when it is set up as an anode against pure lead cathodes. Batteries made using positive grids which have been pickled in hydrogen peroxide--sulfuric acid mixtures, then brightened by dipping in a 10% aqueous solution of diethylene triamine were shown to have a greater life on charge/discharge cycles than batteries made using standard unpickled grids.

4236 EFFECT OF COPPER ON ANODIC CORROSION RATE IN $H_2SO_4$, MECHANICAL PROPERTIES, AND FLUIDITY OF LEAD AND LEAD ANTIMONY ALLOYS. Kirow, A.; Rogatschev, T.; Denew, D. (Forschungsinstitut fuer Nichteisenmetalle NIPKIZM, Sofia). Metalloberflaeche; 26: No. 6, 234-237(Jun 1972). (In German).
Experimental data are plotted for Pb alloys with 0 to 11.57% Sb and 0 to 2% Cu. Mechanical strength and fluidity increase slightly with increase of Cu to 0.06%, then decrease with larger copper additions. The combined effects of Sb and Cu on $H_2SO_4$ corrosion resistance of lead are complex. Starter batteries of a Pb-6.12.Sb--0.069Cu alloy were found to be superior in service to those with Pb--Sb alloys.

4237 METAL OXIDE FABRICS. Hamling, B.H. (to Union Carbide Corp.). US Patent 3,663,182. 16 May 1972. Filed date 1 Nov 1963. 7p.
Patent; continuation of US Patent 3,385,915; for use as fuel cell or battery separators. ELECTRIC BATTERIES;ZIRCONIUM OXIDES;TANTALUM OXIDES;CORROSION RESISTANCE;BATTERY SEPARATORS; FUEL CELLS;ELECTRICAL INSULATORS;REFRACTORIES; CELLULOSE;MATRIX MATERIALS;DESIGN;FABRICATION

4238 TITANIUM ELECTRODES FOR FUEL CELLS AND BATTERIES CONTAINING ACID ELECTROLYTE. Binder, H.; Sandstede, G. (to Battelle-Institut e.V.). German(FRG) Patent 2,054,963. 10 May 1972. Filed date 9 Nov 1970. 20p.
Patent; acid-resistant coating. ACID ELECTROLYTE FUEL CELLS;TITANIUM;ELECTRODES; PROTECTIVE COATINGS;TUNGSTEN OXIDES;SODIUM OXIDES;NICKEL OXIDES;ALUMINIUM OXIDES;STRONTIUM OXIDES;FABRICATION;CARBON;POLYETHYLENES;TEFLON; LEAD-ACID BATTERIES;CORROSION RESISTANCE

4239 EFFECT OF THE LEWIS BASICITY OF ORGANIC SOLVENTS ON THE ELECTROCHEMICAL BEHAVIOR OF METAL HALIDE ELECTRODES. Clinckspoor, G. (Univ., Bonn). Metalloberflaeche; 26: No. 5, 191-196(May 1972). (In German).
The purpose of the investigation was to study the suitability of the chlorides and fluorides of silver, copper, and nickel as cathode material in high-energy batteries in which lithium is used as the anode material in proton-free organic solvents (specifically propylene carbonate). The results are negative because no solvents could be found having all the required properties, which are analyzed. Investigation of NiS and CuS as conducting cathode material is suggested as an alternative.

4240 EFFECT OF THE LEWIS BASICITY OF ORGANIC SOLVENTS ON THE ELECTROCHEMICAL BEHAVIOR OF METAL HALIDE ELECTRODES. Clinckspoor, G. (Univ., Bonn). Metalloberflaeche; 26: No. 5, 191-196(May 1972). (In German).
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4241 ELECTRODE STRUCTURES FOR METAL/OXYGEN BATTERIES AND FUEL CELLS. Gregory, D.P. (to Energy Conversion Ltd.). British Patent 1,272,095. 26 Apr 1972. Filed date 21 Mar 1969. 4p.
FUEL CELLS;METAL-GAS BATTERIES;CATHODES; TEFLON;PVC;DIFFUSION;FABRICATION;DESIGN

4242 SOLID-STATE IONICS - SOLIDS WITH HIGH IONIC CONDUCTIVITY IN THE SYSTEMS SILVER IODIDE--SILVER OXYACID SALTS. Takahashi, T.; Ikeda, S.; Yamamoto, O. (Nagoya Univ., Japan). J. Electrochem. Soc.; 119: No. 4, 477-82(Apr 1972).
SOLIDS;IONIC CONDUCTIVITY;SILVER IODIDES; ELECTROLYTES;ELECTROCHEMISTRY;SILVER PHOSPHATES; SILVER COMPOUNDS;PYROPHOSPHATES;PHASE DIAGRAMS; ELECTRIC BATTERIES

4243 ACTIVE MATERIAL ELECTRODE AND CELL COMPRISING IMPROVED BATTERY-GRADE DIVALENT SILVER OXIDE. Tvarusko, A. (to ESB Inc.). US Patent 3,650,832. 21 Mar 1972. Filed date 12 Nov 1965. 5p.
An additive for silver oxide electrodes improves electric conductivity and/or stability in electrolyte. Selenium, tellurium, mercury, or a combination of mercury with tin or lead may be used. (RWR)

4244 HEATING DEVICE FOR VEHICLE STORAGE BATTERIES. Jordan, H.J. (to ESB Inc.). US Patent 3,649,366. 14 Mar 1972. Filed date 19 Feb 1970. 5p.
Heat is supplied by a resistive coating or a metallic foil bonded to the outside of the battery case. Power can be obtained from the vehicle or an external source. (RWR)

4245 POROUS CARBON MATERIAL FOR USE AS A BATTERY OR FUEL CELL ELECTRODE. Reed, M.W. Jr.; Schwemer, W.C. (to Advanced Tech. Center, Inc.). US Patent 3,647,551. 7 Mar 1972. Filed date 7 Nov 1966. 5p.
FUEL CELLS;CARBON;PVC;CATALYSTS;ELECTRODES; FABRICATION;ELECTRIC BATTERIES

4246 MAKING ELECTRODES FOR LEAD--ACID STORAGE BATTERIES. Anderson, J.L.; Nilsson, O.K.G. (to Aktiebolag Tudor). US Patent 3,647,548. 7 Mar 1972. Filed date 5 Jun 1970. 4p.
This electrode is of the type having several rods. The fabrication procedure is discussed. (RWR)

4247 REMOVAL OF NITRATES FROM SINTERED NICKEL STORAGE-BATTERY PLAQUES IMPREGNATED WITH NICKEL SALTS. Nervik, T. (to ESB Inc.). US Patent 3,647,547. 7 Mar 1972. Filed date 26 Aug 1970. 2p.
The presence of nitrates can be deleterious for sealed cells. A more effective procedure for removing nitrates is explained. Basically, it involves treating with solutions of potassium persulfate and then sodium acetate in sodium hydroxide before washing. (RWR)

4248 TUBULAR-TYPE POSITIVE PLATES FOR USE IN LEAD--ACID STORAGE BATTERIES. Cording, W.T. (to ESB Inc.). US Patent 3,647,546. 7 Mar 1972. Filed date 21 May 1970. 4p.
This plate design has a tight-fitting, shrinkable sleeve enclosing the tube and the spine. A multiopening sleeve of this type can surround some or all of the tubes of a single plate. (RWR)

4249 HYDRATING A BATTERY PLAQUE IMPREGNATED WITH A METAL NITRATE IN A HYDROXIDE SOLUTION AND SUBSEQUENT RECOVERY OF THE NITRATE BY-PRODUCT AS CRYSTALS. Bergum, B.C.; Svardal, P.S. (to ESB Inc.). US Patent 3,647,586. 7 Mar 1972. Filed date 22 Jan 1970. 5p.
A method for producing battery electrodes is described. Battery plaque impregnated with cadmium, cobalt, nickel, or silver nitrate is immersed in a hot, concentrated solution of an alkali metal hydroxide, which process results in precipitation of metal (Cd, Co, Ni, Ag) hydroxide within the plaque. The proper methods for handling and recycling the solutions involved to minimize losses are explained. (RWR)

4250 POROUS CARBON MATERIAL FOR USE AS A BATTERY OR FUEL CELL ELECTRODE. Reed, M.W. Jr.; Schwemer, W.C. (to Advanced Technology Center, Inc.). US Patent 3,647,551. 7 Mar 1972. Filed date 7 Nov 1966. 5p.
The preparation of a monolithic material from poly(vinylidene chloride) with a metallic activator distributed uniformly throughout is described. Electrodes made by the process explained are characterized as having good mechanical strength and are electrically conductive. (RWR)

4251 BATTERY SEPARATOR. Arrance, F.C.; Rosa, A.G. (to McDonnell Douglas Corp.). US Patent 3,647,554. 7 Mar 1972. Filed date 17 Apr 1969. 10p.
The separator described is especially useful in high-energy-density batteries with deep discharge cycles, such as Ag/Zn batteries. It consists of a rigid, porous inorganic material (e.g., ceramic) with a flexible coating or film consisting of potassium titanate in the form of short fibers and a curable organic polymer such as poly(phenylene oxide). The coating is cured

to form a porous, flexible structure. Air drying and heating finish the fabrication procedure. (RWR)

4252 USE OF PALLADIUM-CATALYZED AIR CATHODES IN A SECONDARY ZINC-AIR CELL. Thacker, R. (General Motors Corp., Warren, MI). Energy Convers.; 12: No. 1, 17-20(Mar 1972).
ZINC-AIR BATTERIES;PALLADIUM;CATALYSTS; CATHODES;NICKEL;PERFORMANCE

4253 DISPOSABLE ANODE PACKAGE. Hamlen, R.P.; Siwek, E.G. (to Dept. of the Navy). US Patent 3,645,794. 29 Feb 1972. Filed date 19 Feb 1970. 5p.
A disposable anode package for use in mechanically rechargeable metal--air batteries is described. It includes an anode, a cellophane separator, and spacing material between anode and separator. Flocculent material formed at the anode is contained, and the spent anode and its associated by-products can be readily removed. (RWR)

4254 PRODUCING POROUS METAL STRUCTURES FOR BATTERY ELECTRODES. Hein, E.R.; Veit, W.E. (to ESB Inc.). US Patent 3,645,793. 29 Feb 1972. Filed date 1 Jun 1970. 5p.
Zinc and cadmium powders were mixed (individually) with acid solutions and formed into porous electrodes by pressing. Although acetic acid was used, hydrochloric, tartaric, or benzoic acid would also be suitable. Electrodes of good strength resulted. (RWR)

4255 CYCLING BATTERY ELECTRODES IN BULK. Bergum, B.G. (to ESB Inc.). US Patent 3,644,146. 22 Feb 1972. Filed date 6 Feb 1968. 4p.
A device for charging battery electrodes is described. The device consists of two concentric rotating cylinders. An inner barrel serves as a cathode and contains positive electrodes to be regenerated. An outer barrel serves as anode connector and contains negative electrodes. (RWR)

4256 CONTINUOUS WET-PROOFING PROCESS FOR THE CROSS SECTIONS OF ELECTRODES USED IN FUEL CELLS AND HYBRID SYSTEMS. Hollax, E.; Leuschke, W.; Zimmermann, K.; Mai, E. German(GDR) Patent 88,122. 20 Feb 1972. Filed date 24 Jul 1970. 2p.
FUEL CELLS;METAL-GAS BATTERIES;CARBON; BINDERS;WATERPROOFING;ELECTRODES;FABRICATION

4257 DRY-CHARGED, STORABLE NEGATIVE PLATES FOR LEAD STORAGE BATTERIES. Ziegler, S. (to Bosch, Robert, GmbH). German(FRG) Patent 2,039,767. 17 Feb 1972. Filed date 11 Aug 1970. 7p.
After forming and setting, the plates are impregnated with a solution (suspension) of lignin or a lignin compound and then dried. (RWR)

4258 ELECTRODE FOR ELECTROCHEMICAL CELLS. Marchetto, M. (to Siemens AG). German(FRG) Patent 2,037,795. 3 Feb 1972. Filed date 30 Jul 1970. 11p.
A thin, light, nonseparable, two-layer electrode which resists damage from handling and operating conditions is described. It consists of a layer containing a uniform mixture of powdered catalyst and asbestos, covered with a protective layer of fibrous material such as asbestos. A typical catalyst is Raney nickel. A method for preparing such electrodes is discussed. (RWR)

4259 ZINC ELECTRODE CONTAINING AN ADDITIVE TO REDUCE GASSING AT THE ZINC ELECTRODE IN A HEAT-STERILIZED SILVER--ZINC ALKALINE BATTERY. Nordblom, G.F.; James, H.I. (to ESB Inc.). US Patent 3,639,176. 1 Feb 1972. Filed date 4 Sep 1968. 3p.
Sterilization of Ag/Zn batteries at 145° is detrimental to HgO, the usual additive. Since HgS can stand this treatment, zinc electrodes were prepared by mixing HgS about 1:20 with ZnO powder and compressing this mixture into a silver grid. An HgS--PbS additive is also feasible. (RWR)

4260 RANEY METAL SHEET MATERIAL FOR USE AS ELECTRODES. Goldberger, M. (to Catalytic Tech. Corp.). US Patent 3,637,437. 25 Jan 1972. Filed date 2 Nov 1964. 5p.
Aluminum alloyed with such metals as silver, nickel, platinum, iron, or cobalt is heated to just above the melting point and sprayed on an appropriate substrate to form a sheet about 0.1 mm thick. The sheets are leached with a dilute base to remove most of the aluminum. The sheets are for use in gas diffusion electrodes for fuel cells, batteries, and propulsion devices. (RWR)

4261 PREPARING LITHIUM-FILLED FORAMINOUS METAL SUBSTRATES. Hanawalt, B.D. (to Foote Mineral Co.). US Patent 3,634,144. 11 Jan 1972. Filed date 14 Jul 1970. 5p.
A method for preparing lithium battery anodes is described. A metal substrate (such as nickel) is oxidized and then dipped into a bath of molten lithium. It was found that 96% of the porous volume was filled with lithium. (RWR)

4262 METAL ELECTRODES CONTAINING ACRYLONITRILE--BUTADIENE--STYRENE COPOLYMER BINDERS. Von Sturm, F.; Naschwitz, W.; Groepel, D.; Rummel, W. (to Siemens AG). German(FRG) Patent 2,032,549. 5 Jan 1972. Filed date 1 Jul 1970. 14p.
A process for fabricating fuel-cell or electrochemical-cell electrodes consisting of Raney nickel or silver powder and asbestos coatings is described. The metal powder was mixed with an aqueous dispersion of the copolymer binder, pressed, cross-linked, and saponified. (RWR)

4263 STUDY OF LEAD-RICH PB--CD--SB ALLOYS. Rao, P.; Mao, G.W. (Gould Inc., St. Paul, MN). J. Inst. Met.; 100: 13-19(Jan 1972).
During an investigation of the lead/acid battery characteristics of some lead-rich alloys in the Pb--Sb system, the initial results revealed a maximum in tensile properties for an as-cast alloy at a composition of Pb--3.0% Cd--2.5% Sb. The ultimate tensile strength and 0.2% offset yield strength for this alloy are 72.5 MN/m² and 43.5 MN/m², respectively.

4264 EFFECT OF ELECTRODE STRUCTURES ON CAPACITY OF SEALED CELLS DURING CYCLING. Chua, D.; Diefendorf, R.J. (Rensselaer Polytechnic Inst., Troy, NY). pp 52-55 of Proceedings of the 25th power sources symposium. Red Bank, NJ; PSC Publications Committee (1972).
From 25. power source symposium; Atlantic City, New Jersey, USA (23 May 1972).
See CONF-720527--.

Cd electrode. NICKEL-CADMIUM BATTERIES; ELECTRODES;CADMIUM;BATTERY CHARGING;TEMPERATURE DEPENDENCE

4265 LIGHTWEIGHT SPONGE NEGATIVE PLATES FOR NICKEL--CADMIUM BATTERIES. Carr, E.S. (Eagle-Picher Industries, Joplin, MO). pp 57-60 of Proceedings of the 25th power sources symposium. Red Bank, NJ; PSC Publications Committee (1972).
From 25. power source symposium; Atlantic City, New Jersey, USA (23 May 1972).
See CONF-720527--.
NICKEL-CADMIUM BATTERIES;PLATES;CATHODES; FABRICATION;PERFORMANCE;TESTING

4266 LONG-LIFE, HIGH ENERGY NI--CD AEROSPACE CELLS. Tanis, C. (Air Force Materials Lab., Wright-Patterson AFB, OH); Lander, J.J. pp 55-57 of Proceedings of the 25th power sources symposium. Red Bank, NJ; PSC Publications Committee (1972).
From 25. power source symposium; Atlantic City, New Jersey, USA (23 May 1972).
See CONF-720527--.
NICKEL-CADMIUM BATTERIES;BATTERY SEPARATORS; POLYETHYLENES;TESTING;AIRCRAFT

4267 CYCLE-LIFE STUDY OF SODIUM/BETA-ALUMINA/ SULFUR CELL. Silverman, H.P.; Seo, E.T.; Sayano, R.R.; Toy, A.; Richardson, N.A. (TRW Systems Group, TRW Inc., Redondo Beach, CA). pp 47-9 of Proceedings of 7th Intersociety Energy Conversion Engineering Conference, Hilton Inn, San Diego, California, September 25-29, 1972. Washington, DC; American Chemical Society (1972).
From 7. intersociety energy conversion engineering conference; San Diego, California, USA (25 Sep 1972).
SODIUM-SULFUR BATTERIES;ALUMINIUM OXIDES; PERFORMANCE;LIFETIME;ELECTRIC POTENTIAL; ELECTRIC CURRENTS;FABRICATION

4268 NONLEAKING BATTERY TERMINALS. Snider, W.E.; Nagle, W.J. (NASA, Lewis Research Center, Cleveland, OH). pp 125-9 of Proceedings of 7th Intersociety Energy Conversion Engineering Conference, Hilton Inn, San Diego, California, September 25-29, 1972. Washington, DC; American Chemical Society (1972).
From 7. intersociety energy conversion engineering conference; San Diego, California, USA (25 Sep 1972).
KOH electrolytes. SILVER-ZINC BATTERIES; SEALS;SPACE VEHICLES;SATELLITES;POTASSIUM HYDROXIDES;TESTING;ELECTRODES

4269 ZINC ELECTRODE SHAPE CHANGE IN SECONDARY CELLS. McBreen, J. (Electrochem. Dep., Gen. Mot. Corp., Warren, MI). J. Electrochem. Soc.; 119: No. 12, 1620-8(1972).
NICKEL-ZINC BATTERIES;SILVER-ZINC BATTERIES; ZINC-MANGANESE BATTERIES;ELECTRODES;SHAPE; CHEMICAL REACTION KINETICS;ELECTROCHEMISTRY

4270 CHARGING NICKEL--CADMIUM AND LEAD--ACID BATTERIES FROM COMMON GENERATOR. Hunter, B. (Ordnance Eng. Div., FMC Corp., San Jose, CA). Power Sources Symp., Proc.; 25: 85-8(1972).
NICKEL-CADMIUM BATTERIES;LEAD-ACID BATTERIES; BATTERY CHARGING;BATTERY CHARGERS;ELECTRONIC CIRCUITS

4271 OXIDATION OF PB IN $H_2SO_4$. Archdale, G.; Harrison, J.A. (Univ. of Newcastle-on-Tyne, Eng.). pp 437 of Twenty-third meeting of the International Society of Electrochemistry. Stockholm; International Society of Electrochemistry (1972).
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4272 NEW RECHARGEABLE MERCURY/MERCURY OXIDE ELECTRODE. Jung, M. (VARTA Forschungs- und Entwicklungszentrum, Kelkheim, Ger.). pp 441-443 of Twenty-third meeting of the International Society of Electrochemistry. Stockholm; International Society of Electrochemistry (1972).
From 23. meeting of the international Society of Electrochemistry; Stockholm, Sweden (27 Aug 1972).
ELECTRIC BATTERIES;CATHODES;MERCURY;MERCURY OXIDES;ELECTRODES;FABRICATION;PERFORMANCE

4273 REACTION LAYERS AND ELECTROCHEMICAL PROPERTIES IN TUBULAR ELECTRODES DUE TO ENGINEERING DESIGN. Lindholm, A. pp 447-449 of Twenty-third meeting of the International Society of Electrochemistry. Stockholm; International Society of Electrochemistry (1972).
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ELECTROCHEMISTRY;ELECTRODES;TUBES;LEAD-ACID BATTERIES;CATHODES;PERFORMANCE;FABRICATION; CONSTRUCTION;ELECTRIC CONDUCTIVITY;ELECTRIC POTENTIAL

4274 ELECTROLYTE DISTRIBUTION AND SHIFT THROUGH CARBON ELECTRODES FOR THE ELECTROREDUCTION OF AIR OXYGEN. Mrha, J.; Jindra, J.; Musilova, M. (Inst. of Physical Chemistry and Electrochemistry, Prague). pp 453 of Twenty-third meeting of the International Society of Electrochemistry. Stockholm; International Society of Electrochemistry (1972).
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METAL-GAS BATTERIES;CATHODES;ELECTROLYTES; DISTRIBUTION;AIR;OXYGEN;REDUCTION;CARBON;TEFLON; ELECTROCHEMISTRY

4275 ELECTRODES FOR IRON--AIR SECONDARY CELLS. Nippe, M.W.; Cnobloch, H.; Groppel, D.; Siemsen, G.; von Sturm, F. (Siemens A.G., Erlangen, Ger.). pp 457-459 of Twenty-third meeting of the International Society of Electrochemistry. Stockholm; International Society of Electrochemistry (1972).
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Emphasis on iron. METAL-GAS BATTERIES;IRON; AIR;AUTOMOBILES;ELECTRIC-POWERED VEHICLES; ELECTROCHEMISTRY;DESIGN;PLASTICS;RESINS;ANODES; ELECTRIC POTENTIAL;CATHODES;PERFORMANCE

4276 SELF-DISCHARGE OF IRON ELECTRODES WITH HYDROGEN EVOLUTION IN ALKALINE SOLUTIONS. Ojefors, L. (Royal Inst. of Tech., Stockholm). pp 460-462 of Twenty-third meeting of the International Society of Electrochemistry. Stockholm; International Society of Electrochemistry (1972).
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4277 ION-SELECTIVITY AND DIFFUSION POTENTIALS IN CORROSION LAYERS. PBSO$_4$ FILMS ON PB IN $H_2SO_4$. Ruetschi, P. (Leclanche S.A., Yverdon, Switzerland). pp 463-465 of Twenty-third meeting of the International Society of Electrochemistry. Stockholm; International Society of Electrochemistry (1972).
From 23. meeting of the international Society of Electrochemistry; Stockholm, Sweden (27 Aug 1972).
LEAD-ACID BATTERIES;ANODES;LEAD;CORROSION; PHASE STUDIES;ELECTROCHEMISTRY;ELECTRIC POTENTIAL;DIFFUSION

4278 INFLUENCES OF FOREIGN METAL IONS ON THE PERFORMANCES OF NICKEL POSITIVE ELECTRODES. Sugita, K.; Ohkuma, S. (Railway Technical Research Inst., Tokyo). pp 467-469 of Twenty-third meeting of the International Society of Electrochemistry. Stockholm; International Society of Electrochemistry (1972).
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IMPURITIES;IONS;NICKEL-CADMIUM BATTERIES; CATHODES;NICKEL OXIDES;CHEMICAL REACTIONS; PERFORMANCE;SINTERED MATERIALS;ELECTRIC BATTERIES

4279 DISCUSSION OF VARIOUS TYPES OF TEST ELECTRODES FOR THE EVALUATION OF CATALYSTS FOR THE ELECTROREDUCTION OF OXYGEN. Behret, H.; Binder, H.; Koehling, A.; Sandstede, G. (Battelle Institut, Frankfurt am Main). pp 421-423 of Twenty-third meeting of the International Society of Electrochemistry. Stockholm; International Society of Electrochemistry (1972).
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METAL-GAS BATTERIES;FUEL CELLS;AIR;CATALYSTS; OXYGEN;REDUCTION;CATHODES;TESTING;ELECTRODES

4280 ORGANIC CATHODES WITH AIR REGENERATION. Alt, H.; Binder, H.; Koehling, A.; Sandstede, G. (Battelle-Inst. e.v., Frankfurt/Main, Ger.). pp 333-43 of Electrocatalysis Fuel Cells. Sandstede, G. (ed.). Seattle, Wash.; Univ. Wash. Press (1972).
Quinones mixed with graphitized C. QUINONES; GRAPHITE;CATHODES;ELECTRIC BATTERIES; ELECTROLYTES;ORGANIC COMPOUNDS;CHLORANIL; POLARIZATION

4281 POROUS ELECTRODE STRUCTURES FOR METAL--AIR BATTERIES. Lindstroem, O.; Hasselbo, A.; Moren, C. (R. Inst. Technol., Stockholm, Sweden). Kem-Tek 2 Congr., (Papers), 1971; 6: No. 6, 5p.(1972).
Methods for determining mass-transfer properties. METAL-GAS BATTERIES;ELECTRODES;MASS TRANSFER

4282 THEORETICAL MODEL FOR THE POROUS LEAD(IV) OXIDE ELECTRODE IN THE LEAD--ACID BATTERY. Simonsson, D. (R. Inst. Technol., Stockholm, Sweden). Kem-Tek 2 Congr., (Papers), 1971; 6: No. 5, 12p.(1972).
LEAD-ACID BATTERIES;LEAD OXIDES;CATHODES; MATHEMATICAL MODELS;ONE-DIMENSIONAL CALCULATIONS;MASS TRANSFER;CHARGE TRANSPORT; SULFURIC ACID;ELECTRIC CURRENTS

4283 ACTIVE CONTROL HEAT PIPE PERFORMANCE FOR LONG-LIFE BATTERY COOLING. Fleischman, G.L.; Wanous, D.J. (TRW Systems Group, Redondo Beach, CA). New York; ASME (1972). 8p.
HEAT PIPES;SPACE VEHICLES;HEAT TRANSFER; ELECTRIC BATTERIES;COOLING;ALUMINIUM;AMMONIA; FEEDBACK;PERFORMANCE

4284 MECHANISM OF THE PROCESSES OF FORMATION OF LEAD--ACID BATTERY POSITIVE AND NEGATIVE PLATES. Pavlov, D. (Bulgarian Acad. Sci., Sofia). pp 135-49 of Proceedings of the symposium on batteries for traction and propulsion, Columbus, Ohio, 7-8 Mar 1972. Columbus, OH; Electrochemical Society (1972).
From Symposium on batteries for traction and propulsion; Columbus, OH (7-8 Mar 1972).
LEAD-ACID BATTERIES;ELECTROCHEMISTRY; CHEMICAL REACTION KINETICS;ELECTRODES; FABRICATION

4285 (AD/A--005060) EFFECT OF COBALT ON THE CHARACTERISTICS OF LAMELLAR STRUCTURE NICKEL OXIDE ELECTRODES OPERATING IN A ZINCATE ELECTROLYTE. Kuzmin, Yu.A.; Mashevich, M.N.; Uflyand, N.Yu.; Frolova, S.P. Translated from Sb. Rab. Khim. Istochnikam Toka; 7: 163-167(1972). 9p. (FSTC-HT--23-0999-74). NTIS $3.25.
A lamellar structure nickel oxide with an additive of cobalt has stable and high efficiency for nickel (68--75 percent) in a zincate electrolyte. Replacing the nickel oxide with a metal ceramic lamellar structure electrode with cobalt additive results in a low-cost nickel-zinc storage battery; in specific characteristics it is close to cadmium-nickel and iron-nickel, with average discharge voltage exceeding the voltage of the latter by 0.4 V, that is, by 32 percent. (GRA)

4286 (AD/A--006079) EFFECT OF THE ELECTROLYTE TEMPERATURE DURING CHARGING OF PLATES ON THE CHARACTERISTICS OF ELECTRODES AND CELLS OF LEAD--ACID AUTOMOTIVE STORAGE BATTERIES. Bordt, E.F.; Novoderezhkin, V.V.; Kudzevich, Z.S. Translated from Sb. Rab. Khim. Istochnikam Toka; 7: vp.(1972). 16p. (FSTC-HT--23-1000-74). NTIS $3.25.
A study was made of the effect that increasing the initial electrolyte temperature from 20 to 40 and increasing the process-averaged temperature from 40 to 64 has on the characteristics of electrodes and automotive batteries based on these electrodes. (GRA)

4287 SOLID ELECTROLYTES FOR BATTERIES. Baukal, W. (Battelle Institut eV, Frankfurt am Main). pp 345-359 of From electrocatalysis to fuel cells. Sandstede, G. (ed.). Seattle; University of Washington Press (1972).
New types of solid electrolytes have been discovered during the last few years, and applications in new battery systems have been developed. The properties of the most important solid electrolytes are reviewed, and a tentative classification is presented. Most of the early battery systems contained silver halides as electrolyte. Modern batteries include the compounds $Ag_3SI$, $RbAg_4I_5$, LiI, $CaF_2$, and $\beta$-$Al_2O_3$. The review covers the state of development of these batteries, the problems encountered in practice with the individual systems, and their possible applications. 1 figure, 4 tables, 73 references.

4288 ANODIC OXIDATION OF SODIUM AND LITHIUM

AMALGAMS. Deprez, J.; Rialland, J.F.; Robert, J. J. Chim. Phys.; 69: No. 10, 1440-1444(1972). (In French).
Dissolving alkali metals in mercury enables reduction of the rate of their anodic oxidation in aqueous media. These amalgams can be used as anodes which result in higher power densities than more typical electrodes. Oxidation of Li and Na amalgams is discussed, along with interfering reactions. (RWR)

4289 IMPROVEMENT OF THE PRODUCTION OF CERMET ELECTRODES FOR NICKEL--CADMIUM STORAGE BATTERIES. Shul'gina, G.A. Tr. Novocherkassk. Politekh. Inst.; No. 266, 96-99(1972). (In Russian).
NICKEL-CADMIUM BATTERIES;PRODUCTION;CERMETS; CHEMICAL PREPARATION;HYDROXIDES;ELECTRODES; NITRATES;CHLORINE IONS;TEMPERATURE DEPENDENCE

4290 ELECTROCHEMISTRY OF MOLTEN SALTS. Inman, D.; Graves, A.D.; Nobile, A.A. (Imperial Coll. of Science and Tech., London). Electrochemistry; No. 2, 61-116(1972).
312 references. MOLTEN SALTS; ELECTROCHEMISTRY;MASS TRANSFER;DIFFUSION; ELECTRIC CONDUCTIVITY;ELECTRODES;ELECTROLYSIS; HIGH-TEMPERATURE FUEL CELLS;REVIEWS;METAL-NONMETAL BATTERIES;ELECTROLYTES

4291 FORMING LEAD-BASED ANODES. Ogorodnichuk, V.I.; Voitsekhovich, R.I. Otkrytiya, Izobret., Prom. Obraztsy, Tovarnye Znaki; 49: No. 6, 88(1972).
Lead-based anodes can be produced by forming a layer of lead dioxide by chemical treatment in a solution of sulfuric acid in potassium permanganate at 80 to 100°. The solution is mixed by compressed air. (RWR)

4292 MECHANISM OF THE FORMATION OF BLISTERS ON THE LEAD ELECTRODE OF THE LEAD--ACID BATTERY. Yarnell, C.F. (Bell Telephone Labs., Inc., Murray Hill, NJ). J. Electrochem. Soc.; 119: No. 1, 19-24(1972).
Charging of a lead-acid battery sometimes leads to formation of blisters on the anode. The mechanism of this process was investigated. It was found that a fissure develops between lead formed from a lead sulfate surface layer and lead in the center of the electrode. Hydrogen trapped in this fissure pushes the surface layer out to form the blister. Blistering can be eliminated in low concentrations of electrolyte. (RWR)

4293 NICKEL HYDROXIDE ELECTRODE. V. ANALYSIS AND ELECTROCHEMICAL BEHAVIOR OF CADMIUM--NICKEL--HYDROXIDES. Bode, H.; Denmstedt, W. Electrochim. Acta; 17: No. 4, 609-618(1972). (In German).
Chemical reactions of cadmium and nickel hydroxides in potassium hydroxide are discussed. (RWR)

4294 NEW WATER-ACTIVATED LEAD--ACID BATTERY CONCEPT. Amlie, R.F.; Weissman, E.Y.; Morehouse, C.K.; Qureshi, N.M. (Globe-Union, Inc., Milwaukee). J. Electrochem. Soc.; 119: No. 5, 568-571(1972).
A reserve-type lead--acid battery is based on water-soluble $H_2SO_4$ gels (with small amounts of $H_3BO_3$ and $H_3PO_4$). These gels perform well when properly prepared. Included in the discussion are performance, lifetime, and composition of the electrolyte. (RWR)

4295 HERMETIC COMPRESSION SEALS FOR ALKALINE BATTERIES. McHenry, E.J.; Hubbauer, P. (Bell Telephone Labs., Inc., Murray Hill, NJ). J. Electrochem. Soc.; 119: No. 5, 564-568(1972).
Two new types of seals were developed for use in nickel--cadmium or other alkaline batteries. One is a simpler, smaller version of an existing type of seal. The other uses an injection-molded nylon bushing. Accelerated thermal cycle tests were used to evaluate the reliability of the seals. (RWR)

4296 QUINONES AS REDOX SYSTEMS FOR OXYGEN CATHODES OR SECONDARY CELL CATHODES. Alt, H.; Binder, H.; Klempert, G.; Koehling, A.; Sandstede, G. (Farbwerke Hoechst AG, Frankfurt am Main). Chem.-Ing.-Tech.; 44: No. 4, 195-198(1972). (In German).
Chloranil and duroquinone, when mixed as solids with carbon, can serve as electrodes; they can be reduced and oxidized with only slight polarization. Electrodes made hydrophobic with teflon can be recharged with air. Quinones are stable and rechargeable in electrolytes with aprotic organic solvents. (RWR)

4297 ELECTROCHEMICAL DETERMINATION OF THE RATE OF ZINCATE DIFFUSION THROUGH A HYDRATE-CELLULOSE SEPARATOR. Mikhalenko, M.G.; Flerov, V.N. (Gorky Polytechnic Inst., USSR). Elektrokhimiya; 8: No. 1, 81-83(1972). (In Russian).
A cell was provided with a separating partition containing a 4-$cm^2$ hole covered by a hydrate-cellulose separator. With potassium hydroxide in the catholyte, the diffusion coefficient at room temperature decreased as the difference in concentration of zincate in the chamber decreased. Increasing the concentration difference first increased, then decreased the amount of zinc diffusion. Tripling the number of separator layers decreased zinc diffusion considerably. (RWR)

4298 POTENTIODYNAMIC STUDY OF THE EFFECT OF ALUMINUM ON THE BEHAVIOR OF AN IRON ELECTRODE IN ALKALINE SOLUTION. Teplinskaya, T.K.; Kochetova, T.I.; Novakovskii, A.M. (Akkumulyatornyi Inst., Leningrad). Elektrokhimiya; 8: No. 3, 380-383(1972). (In Russian).
The effect of aluminum on the charge--discharge processes of a smooth iron electrode in KOH was studied. Additional peaks appeared in the I-V curves as the concentration of Al was raised. The effect of aluminum on the iron electrode was believed to be due to a decrease in the cathodic reduction of $Fe(OH)_2$. (RWR)

4299 MECHANISM OF THE PROCESSES OF FORMATION OF LEAD--ACID BATTERY POSITIVE PLATES. Pavlov, D.; Papazov, G.; Lliev, V. (Inst. of Physical Chemistry, Sofia). J. Electrochem. Soc.; 119: No. 1, 8-19(1972).
In the first step water and sulfuric acid penetrate into the plate; tet-PbO and basic lead sulfates are converted to $PbSO_4$ and $\alpha$-$PbO_2$, which form regions that advance into the paste. In the second step water is consumed in the plate. Lead sulfate is oxidized to $\beta$-$PbO_2$, and the acid diffuses in the direction opposite to that of the first step. The rate-limiting steps of the processes are ion diffusion and migration. (RWR)

4300 1971 F. M. BECKET MEMORIAL AWARD REPORT. PRELIMINARY INVESTIGATION INTO THE BEHAVIOR OF

LEAD ALLOY ANODES IN SULFURIC AND CHROMIC ACID SOLUTIONS. Parker, T.E. (McMaster Univ., Hamilton, Ont.). J. Electrochem. Soc.; 119: No. 1, 13C-25C(1972).
Polarization was measured in dilute sulfuric acid and chromic acid for lead anodes with less than 10 wt. percent tin or antimony. Alloying with antimony decreased passive current, increased range of passivity, and lowered critical potential for passive film formation in sulfuric acid. Brightening current decreased in $CrO_3$ solution. On the other hand, alloying with tin did not improve corrosion resistance of the lead anode. (RWR)

4301 ELECTROCHEMICAL PROPERTIES OF $RbAg_4I_5$ SOLID ELECTROLYTE. II. SILVER ELECTRODE REVERSIBILITY. Scrosati, B.; Butherus, A. (Univ., Rome). J. Electrochem. Soc.; 119: No. 2, 128-133(1972).
Planar silver electrodes were found to be reversible, whereas mixed Ag--electrolyte electrodes were not. It was concluded that a practical rechargeable cell will require planar silver electrodes of very great surface area, and that the cell will have to be designed in such a way as to allow for changes in cell thickness during cycling. (RWR)

4302 CATHODIC DISCHARGE CONTROLLED BY DISSOLUTION KINETICS. Nicholson, M.M.; Iverson, M.L. (North American Rockwell Corp., Canoga Park, CA). J. Electrochem. Soc.; 119: No. 2, 133-138(1972).
The constant-current discharge of a thin-layer cathode with control of the electroactive material by dissolution and diffusion is modeled analytically. Although apparently first worked out for an electrolytic cell, the electrode configuration considered (electrode--electrolyte--planar surface) provides a model of the inner structure of a porous battery cathode. (RWR)

4303 DEVELOPMENT TRENDS IN LEAD MATERIALS. Beyer, B. (Forschungsinstitut NE-Metalle, Freiberg, Ger.). Neue Huette; 17: No. 2, 65-71(1972). (In German).
Chemical and mechanical properties and industrial uses of lead and its alloys are briefly summarized. The following topics are emphasized: lead uses in batteries and bearings, dispersion hardening of lead. (RWR)

4304 (FSTC-HT--23-0343-74) PERFORATOR OF LAMELLAR TAPES FOR ALKALINE STORAGE BATTERY ELECTRODES. Takarev, A.F.; Vdovin, Yu.V.; Gavryushov, A.N. 1972. Translation of USSR Patent 350,075. 5p. NTIS $4.00.
A mechanism for perforating the lamellar tapes used as alkaline battery electrodes is described. The device eliminates the loss of material from the tape in the punching process. This is accomplished by a roller punch and die configuration in which the die inset diameter is a tooth diameter larger than the diameter of the punch tooth.

4305 RECENT ADVANCES IN INSOLUBLE ANODES. Narasimhan, K.C.; Udupa, H.V.K. (Central Electrochemical Research Inst., Karaikudi, India). Chem. Ind. Dev.; 6: No. 2, 26-30(1972).
Review, device unspecified. ELECTRIC BATTERIES;ANODES;REVIEWS

4306 PRESSED-TYPE ALKALINE STORAGE BATTERY. V. ADDITION OF ANTIMONY TO THE NEGATIVE ACTIVE MATERIAL OF THE PRESSED-TYPE NICKEL--CADMIUM STORAGE BATTERY. Yamashita, D.; Yamamoto, Y. (Ritsumeikan Univ., Kyoto). Nippon Kagaku Kaishi; No. 2, 309-313(1972). (In Japanese).
NICKEL-CADMIUM BATTERIES;ANODES;ANTIMONY; CHEMICAL REACTIONS;ADDITIVES;CADMIUM HYDROXIDES; POLYETHYLENES;GRAIN GROWTH;CADMIUM

4307 ELECTRODES FOR USE IN ZINC--HALOGEN ELECTROLYTIC CELLS AND (OR) BATTERIES. Jenkins, J.M. (to Unigate Ltd.). British Patent 1,258,503. 30 Dec 1971. Filed date 21 Feb 1969. 8p.
This electrode consists of an anodizable metal coated with zinc, zinc alloy, or zinc salt. Ammonium chloride can be added to zinc powder to vary electrode porosity. The powder may be applied in any of several different ways. Uses of the electrode include electrolysis cells for brine and batteries for electric-powered vehicles. (RWR)

4308 BATTERY SEPARATORS MADE FROM POROUS SINTERED POLYMER MATERIALS. Hall, C.J. (to Electric Power Storage Ltd.). British Patent 1,258,404. 30 Dec 1971. Filed date 11 Nov 1968. 3p.
A method for making a battery separator is described. A layer of polymer powder is heated until it fuses into a sheet. The sheet is impregnated with a silicate solution and immersed in sulfuric acid. (RWR)

4309 FORMING RECHARGEABLE ELECTRODES UTILIZING AN UNSINTERED FLUOROCARBON BINDER. Rampel, G. (to General Electric Co.). US Patent 3,630,781. 28 Dec 1971. Filed date 13 Jul 1968. 5p.
A method for fabricating electrodes which involves teflon is described. An aqueous dispersion is mixed with the desired electrochemically active material such as zinc or its oxide, cadmium or its oxide, copper or its oxide, silver or its oxide, nickel oxide, etc. After the dispersion is broken, the mixture can be spread on a current collector of such metal as copper. (RWR)

4310 RESERVE BATTERY ELECTRODES USING BONDED ACTIVE MATERIALS. Kilduff, T.J. (to Secretary of the Army). US Patent 3,629,007. 21 Dec 1971. Filed date 6 Aug 1969. 5p.
ELECTRIC BATTERIES;ELECTRODES;FABRICATION; PLASTICS;LAYERS;BONDING;LEAD-ACID BATTERIES

4311 IONENE MEMBRANE SEPARATOR. Moacanin, J.; Tom, H.Y. (to National Aeronautics and Space Administration). US Patent 3,629,161. 21 Dec 1971. Filed date 24 Sep 1969. 3p.
A water-insoluble, permselective membrane was prepared by grafting PVA with a N,N,N',N'-tetramethylhexaonediamine-1,6-dibromohexene copolymer in an aqueous solution containing tetrachloro-o-benzoquinone. The membrane does not swell in water. (RWR)

4312 RESERVE BATTERY ELECTRODES USING BONDED ACTIVE MATERIALS. Kilduff, T.J. (to Dept. of the Army). US Patent 3,629,007. 21 Dec 1971. Filed date 6 Aug 1969. 6p.
Electrodes are fabricated by coating a metal support with a noncorrodible, conducting material, and coating this with the active material. Several methods for applying the coating are discussed. (RWR)

4313 POSITIVE PLATES FOR LEAD--ACID STORAGE

BATTERY CELLS. Hill, S. (to ESB Inc.). US Patent 3,629,006. 21 Dec 1971. Filed date 16 Apr 1970. 3p.
Battery plates are preformed in a weak electrolyte solution, and formation is completed in a strongly alkaline solution. Plates so produced have active materials of almost entirely $\alpha$-$PbO_2$. (RWR)

4314 PRODUCING BETA-ALUMINA ELECTROLYTES. Charles, R.J.; Mitoff, S.P.; Morris, W.G. (to General Electric Co.). US Patent 3,625,773. 7 Dec 1971. Filed date 17 Dec 1969. 3p.
2% MgO was mixed with sodium $\beta$ alumina, and the mixture was formed in a die at 25 kpsi. The resulting material had a resistivity of 12 to 25 $\Omega$-cm at 300°. (RWR)

4315 ELECTRODE--SEPARATOR COMBINATION FOR USE IN BATTERIES. (to McDonnell Douglas Corp.). US Patent 3,625,772. 7 Dec 1971. Filed date 30 Aug 1966. 6p.
The electrode is positioned symmetrically and between two rigid, porous separators of inorganic material which are slightly larger than the electrode to allow for sealing with epoxy around the edges. (RWR)

4316 BATTERY ELECTRODE MATRIXES. Arrance, F.C.; Rosa, A.G. (to McDonnell Douglas Corp.). US Patent 3,625,765. 7 Dec 1971. Filed date 22 Jul 1969. 8p.
A sponge-like material is impregnated with a slurry containing a conducting active anode material and a plastic binder. The electrode made from this material is heated to increasingly high temperatures. The porous matrix which remains can itself be used as an electrode, or its pores can be filled with active material. (RWR)

4317 FLEXIBLE, POROUS BATTERY SEPARATOR. Arrance, F.C.; Rosa, A.G. (to McDonnell Douglas Corp.). US Patent 3,625,771. 7 Dec 1971. Filed date 27 Mar 1969. 12p.
Porous particulate inorganic matter, short-fiber potassium titanate particles, a curable organic polymer, and an organic compound derived from organic acids are mixed. The mixture is dissolved in a volatile solvent, spread on a support, and cured. The film can be applied directly on a battery electrode, cast as a free film or coated on a flexible matrix. (RWR)

4318 FLEXIBLE MATRIX AND BATTERY SEPARATOR EMBODYING IT. Arrance, F.C.; Rosa, A.G. (to McDonnell Douglas Corp.). US Patent 3,625,770. 7 Dec 1971. Filed date 2 Jun 1969. 10p.
The separator is made by immersing a mat of chrysotile asbestos in a 13% solution of poly(phenylene oxide) at 150°F. The results is dip-coated with an inorganic separator material. The product has improved resistance to potassium hydroxide. (RWR)

4319 QUINONE ELECTRODES FOR PRIMARY AND SECONDARY BATTERIES. Alt, H.; Koehling, A.; Von Benda, K.; Sandstede, G.; Binder, H. (to Battelle-Institut e.V.). German(FRG) Patent 2,024,724. 25 Nov 1971. Filed date 15 May 1970. 9p.
ELECTRIC BATTERIES;ELECTRODES;QUINONES

4320 FAST-RECHARGEABLE SEALED NICKEL--CADMIUM BATTERY CELLS COMBINED WITH EXCESS PRESSURE AND TEMPERATURE CONTROLS. Belove, L. (to Sonotone Corp.). US Patent 3,622,397. 23 Nov 1971. Filed date 12 Mar 1968. 10p.
Temperature- and pressure-sensitive switches cut off battery charging current if preset levels are exceeded. A resealable, pressure-responsive vent is also described. (RWR)

4321 NEGATIVE COBALT-POWDER ELECTRODES FOR ALKALINE STORAGE BATTERIES. Schilling, H.H. German(FRG) Patent 2,018,635. 11 Nov 1971. Filed date 18 Apr 1970. 10p.
A method for fabricating electrodes by filling porous containers with cobalt powder to a predetermined vibration density is discussed. A capacity of 0.6 Ah/g of cobalt was found. (RWR)

4322 CHARGING SECONDARY METAL--AIR CELLS. Moran, P.J. (to General Electric Co.). US Patent 3,619,297. 9 Nov 1971. Filed date 26 Jun 1969. 4p.
The electrode described has an electrically conducting substrate impregnated with metal catalyst and a porous, conducting sheet near but insulated from the substrate. Porous separators may be positioned between the substrate and the sheet. (RWR)

4323 SINTERED ZINC ELECTRODE. Arrance, F.C.; Berger, C. (to McDonnell Douglas Corp.). US Patent 3,617,592. 2 Nov 1971. Filed date 1 Apr 1966. 4p.
The electrode described was fabricated by compacting a 3:1 mixture of calcined and uncalcined zinc oxide at 2 to 10 kpsi, sintering the mixture at 600 to 1450°, and electrically converting it to zinc. This ceramic-like electrode was intended for high-energy-density alkaline batteries like the Ag/Zn battery. (RWR)

4324 INTENSIFYING THE PROCESS OF LAMELLAE FORMATION FOR LEAD BATTERIES. Penchev, P.R.; Kolev, S.N.; Gishin, S.S.; Ivanov, S.V.; Stanev, V.I. Elektrotekhnika; No. 11, 58-59(Nov 1971). (In Russian).
Results of investigating the intensification of the electrolytic lamellae (electrodes) formation process for lead batteries are presented. It is shown that by switching the current periodically to the opposite polarity it is possible to increase the current density of formation and significantly shorten the process time.

4325 SEPARATOR FOR A DRY-CHARGE LEAD STORAGE BATTERY. Lauck, H. (to Varta AG). German(FRG) Patent 2,018,472. 28 Oct 1971. Filed date 17 Apr 1970. 9p.
A sintered membrane, this separator was fabricated from a mixture of a powdered thermoplastic and a gel-forming powdered synthetic resin. The material was impregnated with concentrated sulfuric acid. (RWR)

4326 DRY-CHARGE ELECTRODES FOR LEAD STORAGE BATTERIES. Flechsig, E.; Ziegler, S. (to Bosch, Robert, GmbH). German(FRG) Patent 2,018,499. 28 Oct 1971. Filed date 17 Apr 1970. 11p.
Electrodes were prepared by adding resin derivates to the electrode plate active mass. The alkyl resin Collidin MC3 worked successfully. Abietic acid and several of its esters were also used, with favorable results. (RWR)

4327 NICKEL ELECTRODE FOR AN ALKALINE BATTERY. Jost, E.M. (to Texas Instruments Inc.). US Patent 3,615,833. 26 Oct 1971. Filed date 12 Apr 1967. 5p.
A method for fabricating a positive nickel electrode is described. (RWR)

4328 LEAD OXIDE SULFURIC ACID BATTERY HAVING A POSITIVE ELECTRODE COMPRISING A TITANIUM--MOLYBDENUM--ZIRCONIUM ALLOY GRID. Ruben, S. US Patent 3,615,831. 26 Oct 1971. Filed date 18 Feb 1969. 4p.
The cathode described has a grid of β-Ti--Mo--Zr alloy (>75% Ti). The grid has a nonpolarizing gold coating covered with the active lead oxide. The method of fabrication is discussed. $TiOSO_4$ was added to improve lifetime and localized attack. (RWR)

4329 BATTERY SEPARATOR FOR ALKALINE STORAGE BATTERIES. Wetherell, T.J. (to High Energy Processing Corp.). US Patent 3,615,865. 26 Oct 1971. Filed date 26 Jan 1969. 2p.
This separator is composed of a matted web of polymeric fibers, a polymeric saturant, and a coating of acrylic or methacrylic acid. The saturant and coating are irradiated to cross-link them. (RWR)

4330 ZINC ADDITIVE IN NICKEL--CADMIUM CELLS. Johnson, D.H. (to Union Carbide Corp.). US Patent 3,615,830. 26 Oct 1971. Filed date 13 Aug 1969. 5p.
The performance of NiCd batteries was improved by pressing zinc and ZnO into the $Ni(OH)_2$ cathode. (RWR)

4331 BATTERY PASTE EXPANDER MATERIAL. Limbert, J.L.; Procter, H.G.; Poe, D.T. (to General Motors Corp.). US Patent 3,615,788. 26 Oct 1971. Filed date 30 Oct 1969. 4p.
Battery paste expander material for the negative plate of a lead--acid storage battery had the following composition: finely divided carbon; barium sulfate; lignosulfonic acid; sulfur; carbohydrates; and $Ca^{2+}$, $Na^+$, and $NH_4^+$ ions. (RWR)

4332 ELECTROLYTE FOR ACTIVATING A METAL FOIL. Turner, T.S.; Whittle, J.E. (to International Nickel Ltd.). German(FRG) Patent 2,004,469. 21 Oct 1971. Filed date 31 Jan 1970. 5p.
Foils for alkaline storage batteries can be activated with a solution made by adding an ammonium salt to a Ni-amine complex electrolyte. (RWR)

4333 ELECTRODES FOR ELECTROCHEMICAL CELLS. (to Kombinat VEB Galvanische Elemente). French Patent 2,064,666. 27 Aug 1971. Filed date 9 Oct 1969. 6p.
The outer surface of this electrode consists of a layer of nickel powder in solified poly(vinyl acetate). (RWR)

4334 NICKEL HYDROXIDE ELECTRODE. Wagner, O.C.; Sulkes, M.J. (to Dept. of the Army). US Patent 3,597,829. 10 Aug 1971. Filed date 18 May 1969. 2p.
The preparation of an electrode for use in an alkaline nickel battery is described. A nickel hydroxide dispersion is embedded into a nickel foam matrix, dried, and pressed. (RWR)

4335 FERRITE-BASED ACTIVE MATERIAL FOR ALKALINE STORAGE BATTERY NEGATIVE ELECTRODES. Labat, J.; Jarrousseau, J.C. (to Societe des Accumulateurs Fixes et de Traction). French Patent 2,058,489. 2 Jul 1971. Filed date 10 Sep 1969. 7p.
Methods for preparing $CdFe_2O_4$ and $CuFe_2O_4$ are described. Their use results in batteries with higher capacity than those made with iron oxides. (RWR)

4336 ELECTRODES BASED ON COPPER(II) SULFIDE. Dechenaux, V.; Gerbier, G. (to Societe des Accumulateurs Fixes et de Traction). French Patent 2,053,662. 21 May 1971. Filed date 11 Jul 1969. 6p.
The electrodes were prepared by sulfiding powdered copper in two steps. Acetylene black or flake nickel were added to increase conductivity. These electrodes had a capacity of 205 Wh/kg when discharged over 40 hours in a battery with a lithium anode. (RWR)

4337 ELECTRODES FOR ELECTROCHEMICAL CELLS, COMPRISING METAL CHLORIDES AS ACTIVE MATERIAL. Gabano, J.P. (to Societe des Accumulateurs Fixes et de Traction). French Patent 2,052,244. 14 May 1971. Filed date 31 Jul 1969. 7p.
A method for forming CuCl or AgCl electrodes in situ is described; the appropriate metal is reacted with $SOCl_2$. (RWR)

4338 SEPARATORS FOR ELECTROCHEMICAL CELLS. Arrance, F.C. (to McDonnell Douglas Corp.). French Patent 2,050,884. 7 May 1971. Filed date 27 Jun 1969. 17p.
High-strength, low-resistance inorganic separators can be made from mixtures of $FeCr_2O_4$, $MnO_2$, serpentine, dolomite, and bauxite. A stable solid solution of a spinel is formed. The mixture is ground, mixed with wax, and formed into plates which are fused by heating. Characteristics of the plates are given. Silver or zinc batteries with this separator have capacities of 220 to 308 Wh/kg. (RWR)

4339 ELECTRICAL CONDUCTIVITY MEASUREMENTS IN ANHYDROUS HYDROGEN FLUORIDE. Clark, R.P.; Moser, J.R. (Sandia Labs., Albuquerque, NM). J. Electrochem. Soc.; 118: No. 4, 666-9(Apr 1971).
LiF, NaF, $KF.2H_2O$, $SrF_3$, $KNO_3$. HYDROFLUORIC ACID;ELECTRIC CONDUCTIVITY;LITHIUM FLUORIDES; SODIUM FLUORIDES;POTASSIUM FLUORIDES;STRONTIUM FLUORIDES;POTASSIUM NITRATES;LOW TEMPERATURE; QUANTITY RATIO;TEMPERATURE DEPENDENCE; ELECTROCHEMISTRY;ELECTRIC BATTERIES; ELECTROLYTES

4340 CHANGES IN CELLULOSE-BASE SEPARATORS DURING USE IN SILVER--ZINC ELECTRIC BATTERIES. Jovanovic, S.; Rakin, P.; Vojnovic, M. Metalloberflaeche; 25: No. 3, 90-94(Mar 1971). (In German).
The distribution of silver and zinc on the different layers of Ag--Zn separator were determined after different periods of service, and the degree of polymerization of the separator cellophane was analyzed. Zinc metallization was found on all layers, whereas silver metallization occurred mainly next to the positive electrode. Cellophane degradation (considered to be negligible) is analyzed as the combined effect of alkaline hydrolysis and silver salt oxidation.

4341 CATALYST FOR THE REACTION OF HYDROGEN

AND OXYGEN. Tsubota, S. (to Japan Storage Battery Co., Ltd.). Japanese Patent 1971-07,581. 25 Feb 1971. Filed date 25 Feb 1967. 3p.

A palladium catalyst for the recombination of H and O in storage batteries is discussed. A means for chemical preparation of this catalyst is set forth. This catalyst has a higher activity than conventional catalysts. (RWR)

4342 ACTIVE CARBON-PARAFFIN ELECTRODE. Grangaard, D.H. (to Kimberly-Clark Corp.). French Patent 2,044,461. 19 Feb 1971. Filed date 21 May 1969. 12p.

Electrodes used as cathodes in secondary batteries with nickel anodes and NaOH electrolyte are described. They are made by compressing a carbon--paraffin mixture at approximately 160° under 18 to 70 kg/cm² pressure. These electrodes are easily regenerated by exposure to air which is blown past them. (RWR)

4343 CADMIUM-CONTAINING ACTIVE MATERIAL FOR NEGATIVE ELECTRODES OF ALKALINE STORAGE BATTERIES. Ackermann, R.; Unger, D.; Kretzschmar, J.; Flemming, W.; Hofmann, H.; Bauer, R.; Wiesenhuetter, J.; Schwabe, L. German(GDR) Patent 79,519. 5 Feb 1971. Filed date 14 Apr 1969. 3p.

A method for preparing cadmium-containing active material is described. An electrode made from this material showed a current capacity of 215 Ah/kg after the first charging cycle. (RWR)

4344 EFFECT OF SURFACE-ACTIVE ADDITIONS ON THE POLARIZATION DISTRIBUTION IN THE DEPTH OF POROUS ELECTRODES. Aguf, I.A. Elektrotekhnika; No. 2, 55-56(Feb 1971). (In Russian).

The analysis presented is applied to the case where the speed of adsorption of the surface-active materials affecting the potential distribution is limited by the ionization of the responding particles. Equations are derived to show that the uniformity of the operation of the negative electrode of the lead storage battery can be improved by use of the anion-active additions.

4345 BEHAVIOR OF SOME SURFACE-ACTIVE MATERIALS IN THE LEAD STORAGE BATTERIES. Manoim, G.I.; Dasoyan, M.A.; Novoderezhkin, V.V. Elektrotekhnika; No. 1, 52-56(Jan 1971). (In Russian).

Some materials are investigated used in the batteries as depassivators of the negative electrodes (''expanders''). The possibility of their combination with the inhibitors of the lead oxidation drying with air--α-oxynaphthenic acid is also studied, as well as the solubility of the surface-active materials in water. The effect is shown of the surface-active materials on the development of the negative electrode surface during cycling, and upon the speed of sedimentation of the lead dioxide suspension in sulfuric acid.

4346 KINETICS OF DECOMPOSITION OF THE ACTIVE MATERIAL IN SILVER OXIDE ELECTRODES OF CHEMICAL SOURCES OF CURRENT. Kotousov, S.G.; Arkhangel'skaya, Z.P.; Berezina, N.V. J. Appl. Chem. USSR (Engl. Transl.); 44: No. 1, 189-191(Jan 1971).

Translated from Zh. Prikl. Khim.; 44: No. 1, 195-198(Jan 1971).

Constancy of the phase composition of the silver oxide electrodes is the decisive factor in the shelf life of dry-charged silver--zinc cells. The character of the variation of the AgO decomposition rate with time at 20 to 70°C depends on the structure and composition of the active material in the charged electrode and on the oxygen content of the ambient gaseous medium. Higher stability is attained if $Ag_2O$ is used as the original component in the active material and the electrodes are stored in the sealed state. Inclusions of metallic silver in the active material accelerate decompositions of AgO. The efficiency of a cell with silver oxide electrodes after prolonged storage (10 y) can be determined by accelerated storage tests at 50°C for 3 months.

4347 EFFICIENCY OF A CADMIUM ELECTRODE IN A SILVER--CADMIUM BATTERY WITH DIFFERENT DEGREES OF CHARGE. Papazova, E.I.; Nikol'skii, V.A.; Andreeva, G.P.; Berkman, E.A. Sb. Rab. Khim. Istoh. Toka, Nauch.-Issled. Akkumul. Inst.; No. 6, 134-41(1971).

SILVER-CADMIUM BATTERIES;ANODES;EFFICIENCY; ELECTRIC CHARGES;SIZE

4348 DEVELOPMENT OF AN ALKALINE-BATTERY STATE-OF-CHARGE INDICATOR. Lerner, S.; Lennon, H.; Seiger, H.N. (Galton, Ind., Inc., Metuchen, N. J.). pp 135-46 of Power Sources 3: Res. Develop. Non-Mech. Elec. Power Sources, Proc. Int. Symp., 7th 1970. Collins. (ed.). Newcastle upon Tyne, Engl.; Oriel Press (1971).

ELECTRIC BATTERIES;BATTERY CHARGING; MEASURING METHODS;HYDROXIDES;MEASURING INSTRUMENTS

4349 POROUS NICKEL ALKALINE-BATTERY ELECTRODES MADE FROM WOVEN COTTON CLOTH. Williams, N.J.; Ashcroft, T.B.; Turner, T.S. pp 149-67 of Power Sources 3: Res. Develop. Non-Mech. Elec. Power Sources, Proc. Int. Symp., 7th 1970. Collins, D.H. (ed.). Newcastle upon Tyne, Engl.; Oriel Press (1971).

Fabrication and testing, porous structure derived from woven cotton cloth. IRON-NICKEL BATTERIES;NICKEL-ZINC BATTERIES;NICKEL-CADMIUM BATTERIES;CATHODES;NICKEL;ELECTRIC BATTERIES; ELECTRODES;PLATES;FABRICATION;PRODUCTION; TESTING;COTTON;COMPARATIVE EVALUATIONS;SINTERED MATERIALS

4350 THERMAL DECOMPOSITION OF NICKEL AMMINE COMPLEXES FOR PRODUCING THE POSITIVE ACTIVE MASS IN SINTERED ELECTRODES. Beccu, K.D.; Stoehr, H. (Electrochem. Div., Battelle Mem. Inst., Geneva-Carouge, Switz.). pp 169-89 of Power Sources 3: Res. Develop. Non-Mech. Power Sources, Proc. Int. Symp., 7th 1970. Collins, D.H. (ed.). Newcastle upon Tyne, Engl.; Oriel Press (1971).

Fabrication. IRON-NICKEL BATTERIES;NICKEL-CADMIUM BATTERIES;NICKEL-ZINC BATTERIES; PYROLYSIS;NICKEL NITRATES;SINTERED MATERIALS; CATHODES;IMPREGNATION;CHEMICAL PREPARATION; FABRICATION;PLATES;AMMINES;NICKEL COMPLEXES

4351 CHARGING EQUIPMENT FOR THE AUXILIARY BATTERIES OF ELECTRIC ROLLING STOCK. Kuntner, M.; Wasserbauer, H. (Siemens, Munich, Germany). Siemens-Z.; 45 (Spec. Issue): 154-5(1971). (In German).

ELECTRIC-POWERED VEHICLES;BATTERY CHARGERS; RECTIFIERS;THYRISTORS;TRAINS;PERFORMANCE

4352 (AD/A--005978) AUTOMATIC CHARGE--DISCHARGE DEVICE FOR TESTING STORAGE BATTERIES. Koshmin, V.P. Translated from Sb. Rab. Khim. Istochnikam Toka; No. 6, 247-254(1971). 16p. (FSTC-HT--23-173-75). NTIS $3.25.

The article gives a description of and specifications for AZRU-17-0,8, an automatic charge-discharge device. It is used for charging and discharging various kinds of storage batteries with nominal voltages from 12-24 volts and charge currents up to 1.5 a. Discharge current ranges from 0.5 to 10 a. Charging takes place in two steps: first, charge current is stabilized; then, current decreases while charge voltage is stabilized. (GRA)

4353 INVESTIGATION ON FLOATING VOLTAGE OF LEAD--ACID STORAGE BATTERIES. Sada, S.; Haraguchi, S. Rev. Electr. Commun. Lab. (Tokyo); 19: No. 1-2, 99-107(1971).
It was found that the optimum floating charge-voltage for batteries using a 1.215 specific gravity electrolyte is 2.16 V per cell, that the optimum floating charge for specific gravity 1.240 electrolyte batteries is 2.18 V per cell, and that their allowable voltage range is plus or minus 2 percent.

4354 ACTIVE MASS OF THE NICKEL OXIDE ELECTRODE FOR AN ALKALINE STORAGE BATTERY. Shapot, M.B.; Gershman, M.B.; Margolin, E.G. (Accumulator Plant, Leningrad). Izobret., Prom. Obraztsy, Tovarnye Znaki; 48: No. 36, 170(1971).
A method for preparing the active material of a nickel oxide electrode is discussed. Precipitation of cobalt hydroxide is followed by precipitation of nickel hydroxide. The product is filtered, dried, washed, dried again, and ground. (RWR)

4355 ACTIVE SUBSTANCE FOR THE NICKEL OXIDE ELECTRODE OF AN ALKALINE STORAGE BATTERY. Novakovskii, A.M.; Gorkhovikova, L.V.; Drachev, G.G. Otkrytiya, Izobret., Prom. Obraztsy, Tovarnye Znaki; 48: No. 31, 197(1971).
A procedure for preparing the active material for a nickel oxide electrode is discussed. Nickel hydroxide was mixed with graphite and a coated cobalt additive. (RWR)

4356 EXPANDER FOR THE NEGATIVE ELECTRODE OF A LEAD--ACID STORAGE BATTERY. Sapotnitskii, S.A.; Kryukova, L.I.; Yampol'skaya, E.G.; Smirnova, I.A.; Ershova, M.I.; Belodubrovskii, R.B. Otkrytiya, Izobret., Prom. Obraztsy, Tovarnye Znaki; 48: No. 31, 197(1971).
A procedure for preparing an expander is discussed. Lignosulfonates obtained by passing a liquid through a cation exchanger with barium-containing compounds were treated. (RWR)

4357 EXPANDER FOR THE NEGATIVE ELECTRODE OF A LEAD--ACID STORAGE BATTERY. Sapotnitskii, S.A.; Kryukova, L.I.; Yampol'skaya, E.G.; Smirnova, I.A.; Ershova, M.I.; Belodubrovskii, R.B. Otkrytiya, Izobret., Prom. Obraztsy, Tovarnye Znaki; 48: No. 31, 196(1971).
A procedure for preparing an expander is outlined. Lignosulfonic acid is treated with phenols, then mixed with barium sulfate and heated for several hours at about 125° and three atmospheres pressure. (RWR)

4358 MOLYBDENUM TRIOXIDE, A NEW ELECTRODE MATERIAL FOR NONAQUEOUS SECONDARY BATTERY APPLICATIONS. Campanella, L.; Pistoia, G. (Univ., Rome). J. Electrochem. Soc.; 118: No. 12, 1905-1908(1971).
The behavior of $MoO_3$ in $LiAlCl_4$--butyrolactone (I) indicated good cathodic efficiency, low polarization, and low solubility. The redox process was reversible. The results were favorable for use of $MoO_3$ as positive electrode material. (RWR)

4359 POLARIZATION CHARACTERISTICS OF ALLOYED LEAD ANODES. Zubarovskii, A.I.; Kalinovskii, E.A.; Nikiforov, A.F.; Stender, V.V. (Chemical-Technical Inst., Dnepropetrovsk, USSR). Khim. Tekhnol. (Kharkov); No. 17, 94-100(1971). (In Russian).
Polarization curves were measured for lead and lead base alloys in sulfuric acid. For alloys with 0.5 to 20 percent Ag, Ag oxidation was accompanied by transfer of $Ag^+$ ions into solution. The significance of surface conditions was discussed. Results for alloys with 1 to 20 percent Tl are also shown. (RWR)

4360 MODULATION-SPECTROSCOPIC INVESTIGATIONS ON NICKEL ELECTRODES. Gobrecht, H.; Paatsch, W.; Thull, R. (Univ., Berlin). Ber. Bunsenges. Phys. Chem.; 75: No. 12, 1353-1357(1971). (In German).
An optical electrical method to determine the change of the structure of semiconducting passive layers on nickel electrodes is described. Modulated reflection from a passive nickel electrode provides information on the structure of the layer in the potential region between first and second passivity. (RWR)

4361 SWELLING OF THE ACTIVE POSITIVE MATERIAL IN A NICKEL--CADMIUM ALKALINE STORAGE BATTERY. Wojciak, W.; Paszkiewicz, M.; Konopinski, W. (Univ., Poznan, Poland). Poznan. Tow. Przyj. Nauk Pr. Kom. Mat.-Przyr.; 12: No. 5, 333-341(1971). (In Polish).
Investigation showed that the swelling was caused by the increased volume of the phase agglutinating $Ni(OH)_2$ crystallites; the size of the crystallites themselves did not change. (RWR)

4362 SCANNING ELECTRON MICROSCOPE AS A TOOL FOR BATTERY PLATE RESEARCH. Hughel, T.J.; Hammar, R.H. (General Motors Research Lab., Warren, MI). pp 35-59 of Seventh symposium on research and development of non-mechanical and electrical power sources. Collins, D.H. (ed.). Newcastle upon Tyne, Eng.; Oriel Press (1971).
An ''intertwined'' structure was seen in unformed positive plates. It was thought to be tetrabasic $PbSO_4$. On formed negative plates an open dendritic structure was seen. (RWR)

4363 ELECTROCHEMICAL PROPERTIES OF NICKEL HYDROXIDE ELECTRODES. MacArthur, D.M. pp 91-118 of Seventh symposium on research and development of non-mechanical and electrical power sources. Collins, D.H. (ed.). Newcastle upon Tyne, Eng.; Oriel Press (1971).
Reaction processes taking place at hydrated nickel hydroxide electrodes were studied with sintered and film-type electrodes. There was no significant difference between chemical and electrochemical precipitation methods of electrode impregnation. Overcharge, especially at high rates was detrimental. (RWR)

4364 ELECTRICAL CONDUCTIVITY OF ELECTROLYTES USED IN ALKALINE STORAGE CELLS. Antonenko, P.A.; Barsukov, V.Z.; Sagoyan, L.N. (Dnepropetrovsk Chemical-Technology Inst., USSR). Khim. Tekhnol. (Kharkov); No. 23, 42-44(1971).
Use of a colloidal-liquid junction as a simple dc method for measuring the electric

conductivity of KOH, NaOH, LiOH, and KOH + LiOH solutions over a wide temperature range is explained. Concentrations ranged from 3 to 9N; temperature, from -40 to +50°. (RWR)

4365 GAS EVOLUTION STUDIES WITH POWDER COMPACT ZINC ANODES. Ramasamy, N.; Sarangapani, S.; Nityanandan, J.P.; Venkatesan, S.; Aravamuthan, V. (Central Electrochemical Research Inst., Karaikudi, India). Corros. Sci.; 11: No. 11, 873-884(1971).
The corrosion behavior of anode materials was studied to determine effects of electrolyte composition, nature of the zinc anode, type of substrate, and role of inhibitors. It is concluded that a compromise must be reached between optimum performance and anode corrosion. (RWR)

4366 THERMODYNAMIC STUDY OF LITHIUM METAL--ORGANIC ELECTROLYTE BATTERIES. Caiola, A.; Guy, H.; Sohm, J.C. (Ecole Electrochemistry, Grenoble, France). Entropie; No. 40, 24-34(1971). (In French).
Entropy and enthalpy were calculated for lithium--metallic salt pairs to be used in high energy-density storage batteries. Salts considered as a positive electrode were $VF_3$, $CrF_3$, $CrF_2$, $MnF_2$, $FeF_2$, $CoF_2$, $NiF_2$, $CuF_2$, $ZnF_2$, $MoF_3$, $AgF_2$, $SnF_4$, $CrCl_3$, $CuCl_2$, $MoCl_5$, $MoCl_3$, $WCl_6$, $CuSO_4$, $FeS_2$, $CoS_2$, $Co_3S_4$, $NiS_2$, CuS, $MoS_3$, $NiCO_3$, $CoCO_3$, $Cu(HCO_2)_2$, and $CuC_2O_4$. (RWR)

4367 EFFECT OF OP-45 ADDITIVES AND A COPOLYMER OF STYRENE WITH MALEIC ANHYDRIDE ON THE PROPERTIES OF A ZINC ELECTRODE IN ALKALINE SOLUTIONS. Mikhalenko, M.G.; Flerov, V.N. (Gorky Polytechnic Inst., USSR). Izv. Vyssh. Uchebn. Zaved., Khim. Khim. Tekhnol.; 14: No. 12, 1876-1879(1971). (In Russian).
Passivation of large block zinc anodes can be inhibited by styrene--maleic anhydride copolymers or OP-45. These substances also retard aging of zincate solutions and inhibit corrosion of powdered zinc electrodes in Ni/Zn batteries, although they accelerate corrosion of zinc in alkaline solutions low in zinc content. (RWR)

4368 QUINONES AS RECHARGEABLE AND REGENERABLE BATTERY CATHODE AND MATERIALS. Alt, H.; Binder, H.; Koehling, A.; Sandstede, G. (Battelle Inst. eV., Frankfurt am Main). J. Electrochem. Soc.; 118: No. 12, 1950-1953(1971).
Quinones were found to be suitable cathode materials for Zn/air cells and secondary batteries. Volt--amp curves showed reversible behavior for electrodes of chloranil and graphitized carbon. The quinones can be rapidly regenerated with air or oxygen. Duroquinone was also investigated. (RWR)

4369 ACID-RESISTANT GLASS FIBER FOR BATTERY SEPARATORS. Simova, V.; Ruseva, V. Stroit. Mater. Silik. Prom-st.; 12: No. 11, 27-29(1971). (In Bulgarian).
Optimum composition for these glass-cloth separators was 68 percent $SiO_2$, 3 percent $Al_2O_3$, 8.5 percent CaO, 2.5 percent MgO, 13 percent $Na_2O$, and 5 percent ZnO. The glass was fused at 1450° and drawn at about 1100°. (RWR)

4370 PERFORMANCE OF BETA-ALUMINA CERAMIC ELECTROLYTE IN SODIUM--SULFUR CELLS. Miles, L.J.; Wynn Jones, I. (Electric Council Research Center, Capenhurst, Eng.). pp 245-264 of Seventh international symposium on power sources. III. Collins, D.H. (ed.). Newcastle upon Tyne, Eng.; Oriel Press (1971).
Preparation was by zone sintering at 1600 to 900°. A 30-A Na/S cell was made with an electrolyte of about 100 $cm^2$ active area. At 300 to 90° the discharge performance was limited predominantly by the conductivity of the electrolyte. About 20% of the internal voltage drop resulted from polarization phenomena. (RWR)

4371 BATTERY SEPARATOR MATERIALS. Lander, J.J. (Air Force Aero-Propulsion Lab., Wright-Patterson AFB, OH). SAMPE Q.; 3: No. 1, 27-31(1971).
BATTERY SEPARATORS;MATERIALS;REVIEWS

4372 HYDROPHILIC TREATMENT FOR HYDROPHOBIC GAS ELECTRODES. Witherspoon, R.R. (to General Motors Corp.). US Patent 3,779,812. 2 Nov 1970. 7p.
The effective internal reactive surface area of gas electrodes can be increased by coating the electrodes with an alkaline earth metal carboxylate and then converting the carboxylate to its corresponding oxide or hydroxide. Electrodes were fabricated and brushed with a solution of hydrated magnesium acetate dissolved in aqueous isopropyl alcohol. The treated electrodes stabilized in 5 minutes during test, while the untreated ones took 2 hours, at 500 $mA/cm^2$. (RWR)

4373 RECENT PROGRESS IN THE DEVELOPMENT OF SOLID ELECTROLYTE BATTERIES. Hull, M.N. (US Army Electronics Command, Fort Monmouth, NJ). Energy Convers.; 10: No. 4, 215-26(Nov 1970).
ELECTRIC BATTERIES;ELECTROLYTES;SOLIDS; ELECTRIC CONDUCTIVITY

4374 RECTIFIER ASSEMBLY FOR AUTOMOBILE ALTERNATORS. Suenaga, M. (Tokyo Shibaura Electric Co., Ltd., Kawasaki, Japan); Machii, T.; Agawa, Y.; Sawano, T. Toshiba Rev., Int. Ed.; No. 51, 23-27(Nov 1970).
A three-phase, full-wave rectifying circuit called the rectifier assembly is mechanically sturdy because it is free of any soldered leads. It is also moisture resistant through any epoxy resin hermetic seal. The features, manufacturing process, and performance of the rectifier assembly are described.

4375 POWER FOR PORTABLES. Chase, R.F. (General Electric Co., Lynchburg, VA). IEEE Trans. Veh. Technol.; VT-19: No. 4, 248-251(Nov 1970).
A battery charger for mobile two-way radio power supplies is described. The use of a two-level charger with voltage sensing results in lower thermal stress on the battery during a 14- to 16-hr recharge cycle. It also provides information for the user on the state of charge of the battery.

4376 ROLE OF POROSITY IN THE MODERN TECHNOLOGY OF BATTERIES. Euler, K.J. (Varta AG, Hanover). Bull. Schweiz. Elektrotech. Ver.; 61: No. 22, 1054-1058(31 Oct 1970). (In French).
The study is concerned with energy generation in the positive plates of lead and steel storage batteries and dry cells, and the phenomena dependent on their porous structure. During the discharge of the $Pb_2$ plates, $PbSO_4$ elements are formed at the pore ends. The spatial distribution of the electrochemical

phenomena is shown to change very slowly during battery charging and discharging. The polyporous systems in the dry cells are analyzed to show that, for locally dependent porosity, even thick electrodes may evenly discharge.

4377 RECHARGEABLE GALVANIC CELL AND ELECTROLYTE THEREFOR-II. Lee, R.S. (to Union Carbide Corp.). US Patent 3,944,430. 18 Sep 1970. vp.
A rechargeable galvanic cell includes a zinc anode, a cathode, and an electrolyte. The electrolyte comprises an aqueous solution containing soluble zinc and a quaternary ammonium compound in an amount sufficient to suppress formation of dendrites on the zinc anode during charging of the cell, the amount being a concentration of the quaternary ammonium compound in the electrolyte within the range of from about 5 x $10^{-4}$ molar to about 5 x $10^{-1}$ molar.

4378 NEGATIVE PLATES FOR DRY-CHARGED LEAD STORAGE BATTERIES. Fiedler, V.; Malikova, V.; Weber, H. Czech Patent 138,199. 15 Sep 1970. Filed date 4 Sep 1967. 3p.
Impregnation of negative plates with acid solutions of sulfomethylated tannins was found to improve the charging properties at low temperatures. Methods for synthesizing tannins are described. Charging capacity at 0° was 7.3A. (RWR)

4379 POSITIVE GRID DESIGN PRINCIPLES. Cannone, A.G.; Feder, D.O.; Biagetti, R.V. Bell Syst. Tech. J.; 49: No. 7, 1279-1303(Sep 1970).
Accelerated test data which show the superior anodic corrosion and growth behavior of pure lead as compared to lead--calcium and lead--antimony positive grids for lead--acid batteries in float service are presented. A novel grid design concept has been developed and applied to the design of pure lead circular grids. Batteries incorporating these circular grids increase in capacity with age rather than decrease in capacity as do rectangular grids.

4380 POLYVINYL CHLORIDE BATTERY JARS AND COVERS. Huseby, T.W.; Ryan, J.T.; Hubbauer, P. Bell Syst. Tech. J.; 49: No. 7, 1359-1376(Sep 1970).
A detailed materials engineering evaluation of low-cost, high-impact, structurally modified rigid polyvinyl chloride (PVC) has demonstrated that battery jars and covers can be molded from PVC in conventional equipment. The battery jars are flame resistant, transparent, and sufficiently tough to withstand considerable abuse without cracking.

4381 TECHNIQUES FOR BONDING THE POSITIVE PLATES. Cushman, R.H. Bell Syst. Tech. J.; 49: No. 7, 1419-1446(Sep 1970).
Two fusion-bonding processes have been devised for bonding adjacent curved- or flat-lead lugs of the positive plates used in a new lead--acid battery.

4382 ELECTROCHEMICAL COMPATIBILITY OF PLASTICS. Butherus, A.D.; Lindenberger, W.S.; Vaccaro, F.J. Bell Syst. Tech. J.; 49: No. 7, 1377-1392(Sep 1970).
An accelerated test method is described by which the extraction rate of organic residues from the plastic container of a storage battery into the cell electrolyte is predicted, and the electrochemical effects of these residues is determined.

4383 POST SEALS FOR THE NEW BELL SYSTEM BATTERY. Sharpe, L.H.; Shroff, J.R.; Vaccaro, F.J. Bell Syst. Tech. J.; 49: No. 7, 1405-1417(Sep 1970).
A novel post seal for a new storage battery consists of a cylindrical ''clamp'' of a rigid cured epoxy resin molded in place on the lead posts and a flexible one-piece butyl rubber structure attached to the epoxy and to the battery jar cover. Accelerated tests show that the seal effectively slows lead corrosion.

4384 TETRABASIC LEAD SULFATE AS A PASTE MATERIAL FOR POSITIVE PLATES. Biagetti, R.V.; Weeks, M.C. Bell Syst. Tech. J.; 49: No. 7, 1305-1319(Sep 1970).
A reproducible method of synthesizing tetrabasic lead sulfate ($4PbO.PbSO_4$) which produces discrete elongated crystals is discussed.

4385 JAR-COVER SEALS. Dahringer, D.W.; Shroff, J.R. Bell Syst. Tech. J.; 49: No. 7, 1393-1403(Sep 1970).
A novel jar-cover seal was designed and fabricated for a new storage battery. The seal consists of a tongue-and-groove seal joint design (jar and cover, respectively) with an infrared heat absorbing layer at the joint interface which seals the jar and cover surfaces when exposed to high-intensity concentrated infrared energy.

4386 HIGH-TEMPERATURE INSULATION. Meadowcroft, D.B. (Central Electricity Research Lab., Leatherhead, Eng.). Proc. Br. Ceram. Soc.; No. 18, 7-16(Aug 1970).
The high-temperature electrical properties of oxide insulators are reviewed. In particular, the conduction processes and the effects of impurities on resistivity are considered for alumina, beryllia, and magnesia. The factors which may limit the use of oxide insulators at elevated temperatures, such as leakage currents, chemical stability, and thermal shock resistance, are discussed by reference to practical examples, including magnesia-insulated cables, use of insulation in a nuclear environment, and uses of beryllia, magnesia, and alumina, respectively, for insulation in the lithium--chlorine battery, molten-carbonate fuel cell, and MHD power generator duct. Minimum leakage currents, chemical stability, and thermal shock resistance are particularly necessary for the practical use of insulation at high temperatures.

4387 BEHAVIOR OF NICKEL OXIDE ELECTRODES OF ALKALINE CELLS IN CONCENTRATED SOLUTIONS OF NICKEL SALTS. Pozin, Yu.M.; Shtertser, N.I. Zh. Prikl. Khim.; 43: No. 7, 1482-1486(Jul 1970). (In Russian).
The potential of porous nickel plates filled with higher nickel oxide shifts in the negative direction in concentrated neutral $Ni(NO_3)_2$ and $NiCl_2$ solutions owing to reduction of nickel oxides. The rate of reduction of higher nickel oxides is limited by the rate of the accompanying anodic process. The reduction is most rapid in $NiCl_2$ solution, where the anodic process consists of dissolution of metallic nickel, and slower in $Ni(NO_3)_2$ solution, in which nickel is passivated easily. The reduction products of higher nickel oxides are apparently basic nickel salts, because the x-

ray diffraction diagrams of plates treated in $Ni(NO_3)_2$ and $NiCl_2$ solutions show a number of significant deviations from the usual nickelous hydroxide structure.

4388 USE OF POLYAMIDES IN THE ACCUMULATOR INDUSTRY. Zahoran, J.; Kallay, F. Muanyag Gumi; 7: No. 7, 231-232(Jul 1970). (In Hungarian).
For the production of cases and lids for alkaline silver--zinc accumulators, high-impact polystyrene has generally been used. The results of recent tests show that the ''Bonamid'' polyamide produced by Borsodi Vegyi Kombinat (Chemical Works, Borsod) is adequate in all respects for this purpose.

4389 THERMODYNAMICS OF LITHIUM AND POTASSIUM IODIDE IN ANHYDROUS PROPYLENE CARBONATE. Salomon, M. (NASA Electronics Research Center, Cambridge, MA). J. Electroanal. Chem. Interfacial Electrochem.; 26: No. 2-3, 319-329(Jul 1970).
The thermodynamic properties of lithium and potassium iodide in anhydrous propylene carbonate were determined by the emf method. Ion-pairing effects are negligible and the solvation of anions increases from Cl- to I-. This order is opposite to that in aqueous solution. Free energies and enthalpies of solvation for the alkali halides and several other salts were calculated. The experimental work consisted of emf measurements on the cells Li/LiI--PC/TlI,Tl(Hg) and K(Hg)/KI--PC/TlI,Tl(Hg).

4390 USE OF THIRD ELECTRODES IN A SECONDARY ZINC-AIR BATTERY. Postula, J.J.; Thacker, R. (General Motors Corp., Warren, MI). Energy Convers.; 10: No. 2, 45-9(Apr 1970).
ZINC-AIR BATTERIES;BATTERY CHARGING; ELECTRODES;OPERATION

4391 INFLUENCE OF THE POROUS STRUCTURE OF A ZINC ELECTRODE ON ITS ELECTRICAL CHARACTERISTICS. Reshetova, G.N.; Afanas'eva, L.A.; Arkhangel'skaya, Z.P. Zh. Prikl. Khim.; 43: No. 4, 843-847(Apr 1970). (In Russian).
Owing to the use of porous electrodes in current sources, a study was made of the influence of the density of the active material in a porous zinc electrode on its structural characteristics and efficiency under anodic polarization in an alkaline electrolyte (10 N KOH). The true specific surface of electrodes is 8.5 sq m/g at about 70 percent porosity, of the active material, and 0.4 sq m/g at 30 percent porosity. Electrodes in which the total pore volume is 60 to 65 percent of the total volume of the active material have the best electrical characteristics in conjunction with adequate mechanical strength. The coefficient of utilization of the active material in electrodes of optimal porosity is 75 percent at 30 A/sq diam current density. When the porosity is decreased to 30 percent, the coefficient of utilization is only 20 percent. The range of permissible densities of the active material, in which the coefficient of utilization is close to the optimal value and electrode polarization is slight, becomes wider with decrease of the discharge current density and with rise of temperature.

4392 INTERPHASIAL COMPONENTS OF CONVENTIONAL ELECTRODE POTENTIALS. Bockris, J.O. (Univ. of Pennsylvania, Philadelphia). Energy Convers.; 10: No. 2, 41-43(Apr 1970).
Electrode potential measurement questions are discussed which arise when it is attempted to express classical thermodynamic approach in terms of definable potentials of phases. An electrode potential means the difference of the inner potential differences at the metal--solution interface together with the relevant metal phase. A simple system is outlined which is used to describe cell potential in terms of inner potentials. Errors and misconceptions are discussed which originate from neglecting the existence of potential difference at metal--metal junctions and from the confusion about the term electrode potential which is often connected with the metal--solution potential difference.

4393 STUDIES ON AIR BATTERY WITH CAUSTIC ALKALINE ELECTROLYTE. Momose, K.; Ishihara, K.; Miyoshi, J. Natl. Tech. Rep. (Matsushita Electr. Ind. Co., Osaka); 16: No. 2, 201-208(Apr 1970). (In Japanese).
To obtain an efficient electrolyte regenerator in an air battery, the properties of calcium hydroxide were examined in detail, especially porosity of coarse grains. The effects of the grain size of calcium hydroxide, electrolyte concentration, discharge rate, and ambient temperature on the discharge characteristics of air batteries were studied. It was found that calcium hydroxide of from 8 to 48 mesh gives the best performance as a regenerator and that the regenerating efficiency is the highest if potassium hydroxide of 30 percent concentration is used. The efficiency of the electrolyte in these two batteries was found to be about three times higher than that observed in batteries without regenerators.

4394 PROTECTION OF OVERCHARGE AND OVERDISCHARGE WITH CONTACTLESS VOLTAGE SWITCH. Furuishi, H.; Kawamoto, K.; Koyama, Y. Natl. Tech. Rep. (Matsushita Electr. Ind. Co., Osaka); 16: No. 2, 269-276(Apr 1970). (In Japanese).
A new relay circuit was developed for the control of opening and closing of the circuit between power source and applied load by discriminating input signals. A semiconductor relay device was also developed and is now applied as charger for conventional batteries, with successful performance in regard to the protection of overcharge as well with regards the high-rate charge. It also prevents batteries from overdischarge when applied to conventional electrical appliances. In addition, it is reasonably expected that this device can be applied to various control apparatus in combination with detector devices.

4395 REACTION OF OXYGEN AT METALLIC NEGATIVE ELECTRODE (LEAD AND CADMIUM). Sekido, S.; Yamashita, M.; Iizima, T. Natl. Tech. Rep. (Matsushita Electr. Ind. Co., Osaka); 16: No. 2, 217-222(Apr 1970). (In Japanese).
The effects of applied potential, proportion of exposed area, partial pressure of oxygen, concentration of electrolyte, and discharge depth of the electrode are discussed in detail. It was found that two different kinds of reactions occur on the electrode. The one occurs at the exposed area of electrode and is independent of the current. The other is of electrochemical character and occurs at the meniscus region. Different behavior was found between lead and cadmium electrodes for the former reaction.

4396 EFFECT OF THE METHOD OF PRODUCTION ON THE CAPACITY OF SINTERED NICKEL ELECTRODES FOR ALKALINE ELECTRIC STORAGE BATTERIES. Drazic,

D.M.; Vujcic, V.; Rakin, R. Metalloberflaeche; 24: No. 3, 76-77(Mar 1970). (In German).
By using as a matrix a carbonyl nickel/nickel oxide mixture of a composition such that 75 percent of the metallic nickel of the electrode is formed during sintering at 300 C in a hydrogen atmosphere by reduction of the nickel oxide, the conventional repeated salt impregnation of the matrix can be reduced to a single nickel nitrate solution impregnation to obtain electrodes of comparable capacity.

4397 BATTERY WITH ALMOST UNLIMITED LIFE HAS RIGID PVC CASING. Mod. Plast.; 47: No. 2, 42(Feb 1970).
LEAD-ACID BATTERIES;PACKAGING;CYLINDRICAL CONFIGURATION;LIFETIME;PVC;CONTAINERS

4398 NEW STORAGE BATTERY PROMISES LONGER LIFE. Power (N.Y.); 114: No. 2, 73(Feb 1970).
A lead-acid battery with an anticipated life of more than 30 yr uses circular grids made of pure lead.

4399 TRANSISTORIZED CONVERTER FOR AUTOMATIC CHARGING OF SILVER--CADMIUM STORAGE BATTERIES. Venediktov, Yu.P.; Leont'ev, N.I.; Repin, O.M.; Saimukov, V.N. Elektrichestvo; No. 1, 82-83(Jan 1970). (In Russian).
SILVER-CADMIUM BATTERIES;BATTERY CHARGERS; CONTROL SYSTEMS

4400 EFFECT OF DIFFERENT FACTORS ON THE QUALITY OF GRIDS CAST FROM AN ARSENIC ALLOY. Dasoyan, M.A.; Gordyakova, G.N.; Lyandres, A.Z. (USSR). Sb. Rab. Khim. Istochnikam Toka; No. 5, 11-16(1970). (In Russian).
LEAD-ACID BATTERIES;GRIDS;LEAD ALLOYS; ANTIMONY ALLOYS;ARSENIC ALLOYS;FABRICATION; TEMPERATURE DEPENDENCE;HIGH TEMPERATURE;MEDIUM TEMPERATURE;TIN ALLOYS;COPPER ALLOYS;MECHANICAL PROPERTIES

4401 HIGHLY ACTIVE DENSE PASTES MADE FROM LEAD POWDER. Nechiporenko, Z.S.; Novoderezhkin, V.V.; Dasoyan, M.A. (USSR). Sb. Rab. Khim. Istochnikam Toka; No. 5, 38-43(1970). (In Russian).
LEAD-ACID BATTERIES;ANODES;FABRICATION; CHEMICAL PREPARATION;LEAD;LEAD OXIDES;POWDERS

4402 CAPILLARY PROPERTIES OF SEPARATOR FABRICS AND PERFORMANCE OF THE FABRICS IN SEALED STORAGE BATTERIES. Zhivotinskii, P.B.; Bessonova, T.M.; Ivanova, N.I.; Lygovtsova, N.A. (USSR). Sb. Rab. Khim. Istochnikam Toka; No. 5, 63-79(1970). (In Russian).
BATTERY SEPARATORS;NICKEL-CADMIUM BATTERIES; OXYGEN;BATTERY CHARGING;PERFORMANCE

4403 MERCURY ELECTROCHEMICAL COULOMETER AS A BATTERY STATE-OF-CHARGE INDICATOR. Secunde, R.R.; Birchenough, A.G. (NASA, Lewis Research Center, Cleveland, OH). pp 5-28 to 5-32 of Energy 70, Proceedings. Intersociety Energy Conversion Engineering Conference. Volume 1. Hinsdale, IL; American Nuclear Society (1970).
From 5. annual intersociety energy conversion engineering conference; Las Vegas, Nevada, USA (21 Sep 1970).
ELECTRIC BATTERIES;BATTERY CHARGING;ELECTRIC MEASURING INSTRUMENTS;VOLTAMETRY;MERCURY; TESTING;DESIGN;PERFORMANCE

4404 CHEMICAL ANALYSIS OF NICKEL--CADMIUM ELECTRODES. Kroger, H.H.; Catotti, A.J. pp 4-6 of 24th power sources symposium. Red Bank, NJ; PSC Publications Committee (1970).
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NICKEL-CADMIUM BATTERIES;ELECTRODES;CHEMICAL ANALYSIS;PERFORMANCE;SINTERED MATERIALS

4405 ZINC AS A SECONDARY BATTERY ELECTRODE. Dirkse, T.P. (Calvin Coll., Grand Rapids, MI). pp 14-15 of 24th power sources symposium. Red Bank, NJ; PSC Publications Committee (1970).
From 24. power sources symposium; Fort Monmouth, NJ (19 May 1970).
Review of attempts to improve cycling behavior. ZINC;ELECTRIC BATTERIES;NICKEL-ZINC BATTERIES;SILVER-ZINC BATTERIES;ZINC-MANGANESE BATTERIES;ANODES;CHEMICAL REACTIONS;DEPOSITS; REVIEWS;PERFORMANCE

4406 PHYSICAL CHANGES AT LITHIUM ELECTRODES DURING CHARGE--DISCHARGE CYCLING. Semones, D.E.; McCallum, J. (Battelle Memorial Inst., Columbus, OH). pp 16-19 of 24th power sources symposium. Red Bank, NJ; PSC Publications Committee (1970).
From 24. power sources symposium; Fort Monmouth, NJ (19 May 1970).
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4407 LOW COST OXYGEN ELECTRODES. Wynn, J.E.; Knapp, H. (Army Electronics Command, Fort Monmouth, NJ). pp 88-91 of 24th power sources symposium. Red Bank, NJ; PSC Publications Committee (1970).
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Evaluation of various materials. METAL-GAS BATTERIES;OXYGEN;CATHODES

4408 AIR ELECTRODES FOR MECHANICALLY RECHARGEABLE ZINC--AIR BATTERIES. Biddick, R.E.; Cummins, W.J.; Rubischko, R.;. pp 92-94 of 24th power sources symposium. Red Bank, NJ; PSC Publications Committee (1970).
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ZINC-AIR BATTERIES;CATHODES;AIR;ELECTRIC POTENTIAL;ECONOMICS

4409 ACID-RESISTANT GLASS FIBER FOR TUBULAR SEPARATORS. Simova, V.; Ruseva, V. (Nauchnoizsled. Proektno-Konstr. Inst. Stuklo Fina Keram., Sofia, Bulgaria). pp 67-72 of Stuklo Fina Keram., Nauchno-Tekh. Konf., 3rd, 1970. Sofia, Bulgaria; Tekhnika (1970).
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4410 INCREASE AND STABILIZATION OF SILVER ELECTRODE CAPACITY. Andreeva, G.P.; Arkhangel'skaya, Z.P. Sb. Rab. Khim. Istochnikam Toka; No. 5, 132-7(1970).
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4411 ELECTRIC STORAGE BATTERIES FOR VEHICLE PROPULSION. Hietbrink, E.H.; Tricklebank, S.B. (General Motors Corp., Warren, MI).

New York; ASME (1970). 9p.
From ASME meeting; (29 Nov-3 Dec 1970).
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4412 ANOMALIES OF THE NEGATIVE PLATE IN THE LEAD--ACID BATTERY. Simon, A.C. (Naval Research Lab., Washington, DC). pp 33-53 of Power sources 2. Research and development in non-mechanical electrical power sources. Collins, D.H. (ed.). Oxford; Pergamon Press Ltd. (1970).
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LEAD-ACID BATTERIES;ANODES;DENDRITES;LEAD SULFATES;ELECTROCHEMISTRY;PLATES;CHEMICAL REACTION KINETICS

4413 CURING OF LEAD--ACID BATTERY PLATES. Humphreys, M.E.D.; Taylor, R.; Barnes, S.C. (Joseph Lucas (Batteries) Ltd., Birmingham, Eng.). pp 55-67 of Power sources 2. Research and development in non-mechanical electrical power sources. Collins, D.H. (ed.). Oxford; Pergamon Press Ltd. (1970).
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4414 WATER-ACTIVATED DRY-CHARGED LEAD--ACID BATTERIES. Douglas, D.L.; Biddick, R.E.; Ockerman, J.B. (Gould-National Batteries, Inc., Minneapolis). pp 93-101 of Power sources 2. Research and development in non-mechanical power sources. Collins, D.H. (ed.). Oxford; Pergamon Press Ltd. (1970).
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4415 STUDY OF SOME OF THE CRYSTALLOGRAPHIC AND MICROSCOPIC ASPECTS OF THE CURING OF POSITIVE LEAD--ACID BATTERY PLATES. Pierson, J.R. (Globe-Union Inc., Milwaukee). pp 103-119 of Power sources 2. Research and development in non-mechanical power sources. Collins, D.H. (ed.). Oxford; Pergamon Press Ltd. (1970).
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4416 DISTRIBUTION OF POTENTIAL OVER DISCHARGING LEAD--ACID BATTERY PLATES. Puzey, J.E.; Orriel, W.M. (Joseph Lucas Ltd., Shirley, Eng.). pp 121-140 of Power sources 2. Research and development in non-mechanical power sources. Collins, D.H. (ed.). Oxford; Pergamon Press Ltd. (1970).
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LEAD-ACID BATTERIES;PLATES;ELECTRIC POTENTIAL;DISTRIBUTION;GRIDS;DESIGN; MATHEMATICAL MODELS

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4419 COATED NICKEL ELECTRODES. Sheinhartz, I.; Dickinson, C.D. (General Telephone and Electronics Labs., Inc., Bayside, NY). pp 167-179 of Power sources 2. Research and development in non-mechanical power sources. Collins, D.H. (ed.). Oxford; Pergamon Press Ltd. (1970).
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4420 RAPID RECHARGING OF NICKEL--CADMIUM BATTERIES. Carson, W.N. Jr. (General Electric Co., Schenectady, NY); Hadley, R.L. pp 181-197 of Power sources 2. Research and development in non-mechanical power sources. Collins, D.H. (ed.). Oxford; Pergamon Press Ltd. (1970).
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Tests up to 4000 C rate. NICKEL-CADMIUM BATTERIES;BATTERY CHARGING;CONTROL;AIRCRAFT; BATTERY CHARGERS;ELECTRONIC CIRCUITS

4421 ION-EXCHANGE MEMBRANES AS SEPARATORS FOR ORGANIC ELECTROLYTE RECHARGEABLE SYSTEMS. Dey, A.N.; Rao, M.L.B. (P. R. Mallory and Co., Inc., Burlington, MA). pp 231-254 of Power sources 2. Research and development in non-mechanical power sources. Collins, D.H. (ed.). Oxford; Pergamon Press Ltd. (1970).
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Feasibility to retard diffusion of chlorocuprate complexes. ION EXCHANGE MATERIALS; MEMBRANES;BATTERY SEPARATORS;ORGANIC COMPOUNDS; ELECTROLYTES;LITHIUM-COPPER CHLORIDE BATTERIES; ELECTRIC CONDUCTIVITY;LACTONES;DIFFUSION;SELF-DIFFUSION;ELECTRIC-POWERED VEHICLES;CARBONIC ACID ESTERS;COPPER COMPLEXES;LITHIUM OXIDES; ALUMINIUM OXIDES;CHLORINE COMPOUNDS;FEASIBILITY STUDIES

4422 POTENTIAL-TIME STUDY OF THE MASS TRANSFER PHENOMENA DUE TO THE LITHIUM IONS IN NON-AQUEOUS ELECTROLYTES. Gabano, J.P.;

Jumel, Y.; Laurent, J.F. (Societe des Accumulateurs Fixes et de Traction, Poitiers, France). pp 255-265 of Power sources 2. Research and development in non-mechanical power sources. Collins, D.H. (ed.). Oxford; Pergamon Press Ltd. (1970).
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4423 ELECTRODE POTENTIALS AND RELATED PROPERTIES OF SOME POTASSIUM-CONTAINING α-MANGANESE DIOXIDES. Ambrose, J.; Covington, A.K.; Thirsk, H.R. (Univ. of Newcastle upon Tyne, Eng.). pp 303-318 of Power sources 2. Research and developent in non-mechanical electrical power sources. Collins, D.H. (ed.). Oxford; Pergamon Press Ltd. (1970).
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ZINC-MANGANESE BATTERIES;CATHODES;ELECTRIC POTENTIAL;MANGANESE OXIDES;CHEMICAL PREPARATION; ION EXCHANGE;CHEMICAL REACTIONS

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4425 COMPARISON OF AMALGAMATED AND NON-AMALGAMATED ZINC ELECTRODES. Dirkse, T.P. (Calvin Coll., Grand Rapids, MI). pp 411-422 of Power sources 2. Research and development in non-mechanical electrical power sources. Collins, D.H. (ed.). Oxford; Pergamon Press Ltd. (1970).
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4426 APPLICATION OF CHARGING SYSTEMS TO FARM, CONSTRUCTION, AND INDUSTRIAL MACHINERY. Martin, R.A.; Renner, G.R.; Rowls, G.A.; Stenklyft, G.H. New York; Society of Automotive Engineers, Inc. (1970). 15p.
New developments in charging systems offer improvements in performance, life, and reliability when the systems are properly applied to the vehicle. These developments include the Integral Charging System with a built-in integrated-circuit regulator, sealed side-terminal battery, and improved application aids.

4427 BATTERY MATERIALS, 1970. Conrad, P. Park Ridge, NJ; Noyes Data Corp. (1970). 171p.
The publication covers materials for aqueous battery system including lead--acid, silver--zinc, nickel--cadmium and other types of batteries. The ''dry'' battery systems reviewed include zinc, magnesium, aluminum, aminoethylene, mercuric oxide and lead--acid dry cells. The review includes organic, solid, and molten electrolyte systems, as well as radioactive batteries. The review as a whole is based on data from patents and commercially available products.

4428 PREPARATION OF HIGHLY POROUS NICKEL SUBSTRATES FOR SINTERED ELECTRODES OF STORAGE BATTERIES. Chebakov, V.D.; Karev, B.D.; Kukoz, F.I. Tr. Novocherkassk. Politekh. Inst.; 21-23(1970). (In Russian).
A powder layer was sputtered on both sides of a nickel foil and sintered at 950°. (RWR)

4429 VOLUMETRIC DETERMINATION OF LEAD SULFATE CONTENT IN THE ACTIVE MASSES OF LEAD BATTERY ELECTRODES. Sorokina, M.N.; Ryzhkov, E.M. Sb. Rab. Khim. Istochnikam Toka; No. 5, 223-227(1970). (In Russian).
Carboxyarsenazo was used as an indicator in the titration of $SO_4^{--}$ with $Ba(NO_3)_2$ in an aqueous ethanol solution. With this method the phase composition of the active mass of a negative electrode could be determined from one sample. The sample was treated with boiling sodium acetate in sodium formate; the metallic lead was dissolved in nitric acid, and the amount of lead sulfate remaining was determined. (RWR)

4430 EFFECT OF THE DISCHARGE TEMPERATURE ON OPERATIONAL AND STRUCTURAL CHARACTERISTICS OF A SILVER OXIDE ELECTRODE. Ereiskaya, G.P.; Dunaeva, T.I.; Skalozubov, M.F. Tr. Novocherkassk. Politekh. Inst.; No. 217, 36-41(1970). (In Russian).
Tests were made on pressed electrodes in 10N KOH. Lowering the discharge temperature to -10° produced a sharp decrease in the capacitance of the electrodes. Decrease during cycling is less at +90° than at +20°. The submicrostructure of reduced silver on forced discharge systems changed; there was a loss of contact between active mass particles, and these no longer took part in current production. (RWR)

4431 DETERMINATION OF THE DEGREE OF REDUCTION OF ACTIVE MASSES OF A STORAGE CELL IRON ELECTRODE. Galat, N.I.; Kukoz, F.I.; Bogdanov, V.I. Tr. Novocherkassk. Politekh. Inst.; No. 217, 113-115(1970). (In Russian).
The amount of reduction was determined through the magnetic susceptibility. The susceptibility was proportional to [FeO]. (RWR)

4432 FEASIBILITY OF USING MAGNETIC MEASUREMENTS FOR THE SELECTION OF CONCENTRATIONS OF SULFUR ADDITIVES IN THE ACTIVE MASS OF AN IRON ELECTRODE. Galat, N.I.; Babkov, S.N.; Kabanov, N.A.; Kukoz, F.I.; Makarov, V.I. Tr. Novocherkassk. Politekh. Inst.; No. 217, 45-48(1970). (In Russian).
Formulas for calculating the capacitance of iron electrodes for alkaline batteries were presented. (RWR)

4433 EFFECT OF THE CHARGE TIME ON THE LIFE OF A SILVER BATTERY ELECTRODE. Milov, V.A.; Skalozubov, M.F.; Gaivoronskaya, N.P.; Dunaeva, T.I.; Ereiskaya, G.P.; Osipchuk, N.Yu. Tr.

Novocherkassk. Politekh. Inst.; No. 217, 27-31(1970). (In Russian).
The utilization factor of the active mass of the silver electrodes was studied as a function of the number of cycles for various charging times. An electrode which is chargeable to the potential of termination of oxygen liberation showed a high utilization factor for a significant number of cycles. The charge in utilization factor reached a maximum at about a half dozen cycles. (RWR)

4434 OXIDATION OF SINTERED NICKEL BASES WITH OZONE. Khodarev, O.N.; Pervushin, Yu.N.; Skalozubov, M.F. Tr. Novocherkassk. Politekh. Inst.; No. 217, 14-17(1970). (In Russian).
The lower nickel hydroxides were the primary product when sintered nickel bases of nickel oxide electrodes for alkaline batteries were oxidized in a humid $O_3$--$O_2$ mixture. Optimum conditions for oxidation were found. (RWR)

4435 MAGNETIC SEPARATION OF ACTIVE MATERIALS OF AN IRON ELECTRODE. Kukoz, F.I.; Galat, N.I.; Lipkin, S.S.; Makarov, V.I. Tr. Novocherkassk. Politekh. Inst.; No. 217, 52-53(1970). (In Russian).
Materials for an alkaline storage battery were obtained by magnetic separation using a direct and an alternating field. The iron was in powder form. (RWR)

4436 PRODUCTS OF OXIDATION OF NICKEL WITH OZONE. Khodarev, O.N.; Pervushin, Yu.N.; Kudoz, F.I.; Skalozubov, M.F. Tr. Novocherkassk. Politekh. Inst.; No. 217, 10-13(1970). (In Russian).
$\beta$-NiOOH and $Ni(OH)_2$ suitable for use in alkaline storage batteries were obtained by oxidation of Ni in $O_2$ and $O_3$. (RWR)

4437 EFFECT OF LOW-FREQUENCY ACOUSTICAL VIBRATIONS ON THE FORMATION OF ACTIVE MATERIALS OF A LEAD BATTERY POSITIVE ELECTRODE. Sapozhnikov, A.V.; Skalozubov, M.F.; Morozov, V.A. Tr. Novocherkassk. Politekh. Inst.; No. 217, 65-68(1970). (In Russian).
Vibration at 100 Hz of lead battery positive electrodes during formation resulted in a more active $PbO_2$ $\beta$-phase. (RWR)

4438 REDUCTION OF THE CAPACITY OF SILVER ELECTRODES OPERATING IN FORCED DISCHARGE SYSTEMS. Gaivoronskaya, N.P.; Dunaeva, T.I.; Ereiskaya, G.P.; Skalozubov, M.F. Tr. Novocherkassk. Politekh. Inst.; No. 217, 31-36(1970). (In Russian).
It was found that long, slow charging resulted in higher battery capacity. Forced discharges caused a notable increase in electrode surface area. Recommendations for charging modes are suggested. (RWR)

4439 CYCLING OF A POSITIVE LEAD ELECTRODE IN THE AREA OF LEAD SULFATE AND OXYGEN FORMATION POTENTIALS. Molchan, A.G.; Skalozubov, M.F. Tr. Novocherkassk. Politekh. Inst.; No. 217, 63-65(1970). (In Russian).
Charging and discharging times and currents were measured in the areas of oxygen and lead sulfate formation potential. Electrical capacity increased after cycling. The importance of the desorption processes of initially adsorbed lead sulfate molecules is pointed out. After four or five cycles, the amount of electricity obtained from the battery during operation is less than that used to charge the battery. (RWR)

4440 DEVELOPMENT OF MODIFIED POLYOLEFIN MEMBRANES FOR REVERSE OSMOSIS. Hamil, H.F.; Harlowe, W.W. Jr.; Wong, C.M.; Gillam, W.S.; Podall, H.E.; Kindley, L.M. Washington, DC; Office of Saline Water (1970). 58p.
As part of a project to develop a sterilizable battery separator for silver--zinc batteries, a process for the modification of polyethylene film involving grafting with acrylic acid followed by crosslinking using divinylbenzene was developed. Both reactions were initiated by radiation from a cobalt-60 source. Application of the above process to modification of polyethylene films with other monomers capable of free radical polymerization was undertaken to develop a membrane suitable for desalination of sea or brackish water by reverse osmosis.

4441 DETERMINATION OF THE ELECTRONIC TRANSFERENCE NUMBERS OF SOLID ELECTROLYTES. Liant, C.C. (P.R. Mallory and Co., Inc., Burlington, MA). Trans. Faraday Soc.; 65: No. 564, 3369-3374(Dec 1969).
ELECTRIC BATTERIES;ELECTROLYTES;SOLIDS; ELECTROCHEMISTRY

4442 LITHIUM ANODE PROPERTIES IN A NONAQUEOUS CELL. Jackson, G.W. (Union Carbide Corp., Cleveland); Blomgren, G.E. J. Electrochem. Soc.; 116: No. 11, 1483-1487(Nov 1969).
Li/$AlCl_3$ in propylene carbonate/AgCl. SILVER CHLORIDES;PERFORMANCE;POLARIZATION;METAL-NONMETAL BATTERIES;ALUMINIUM CHLORIDES;CARBONIC ACID ESTERS;ANODES;LITHIUM;ELECTROLYTES

4443 ANODES FOR REFUELABLE MAGNESIUM--AIR BATTERIES. Hamlen, R.P.; Jerabek, E.C.; Ruzzo, J.C.; Siwek, E.G. (General Electric Co., NY). J. Electrochem. Soc.; 116: No. 11, 1588-1592(Nov 1969).
The purpose of this work was to select an anode alloy and an electrolyte--separator system for use with magnesium--air cells. The cells are to be employed in a battery with replaceable anodes and electrolyte. This system differs from the silver chloride--magnesium seawater cell in that the product is primarily a hydroxide rather than a chloride, and all of the magnesium hydroxide (or hydroxychloride) product must be contained within the cell rather than being flushed out. Since the product sludge must remain within the cell, the total ampere-hour discharge between refuelings is determined by the volume of sludge per ampere-hour and by the total cell volume available for containment of the sludge.

4444 HIGH-RATE OXIDATION OF SILVER ELECTRODES IN CHLORIDE SOLUTIONS. Bro, P. (P.R. Mallory and Co., Inc., Burlington, MA); Marincic, N. J. Electrochem. Soc.; 116: No. 10, 1338-1341(Oct 1969).
ELECTRIC BATTERIES;CATHODES;SILVER;SILVER CHLORIDES;BATTERY CHARGING;HEATING

4445 ELECTRON MICROPROBE STUDY OF THE ACTIVE MATERIALS IN THE LEAD--ACID STORAGE BATTERY. Chiku, T. (Toyota Central Research and Development Lab., Inc., Nagoya, Japan); Nakajima, K. J. Electrochem. Soc.; 116: No. 10, 1407-1409(Oct 1969).
LEAD-ACID BATTERIES;MATERIALS;MICROANALYSIS; LEAD SULFATES;ANODES;BATTERY CHARGING; ELECTRODES

4446 HIGH RATE OXIDATION OF SILVER ELECTRODES IN CHLORIDE SOLUTIONS. Bro, P.; Marincic, N. (P. R. Mallory and Co., Inc., Burlington, MA). J. Electrochem. Soc.; 116: No. 10, 1338-1341(Oct 1969).

The search for a rechargeable battery cathode capable of accepting a high charging rate with a high efficiency showed that flat silver/silver chloride electrodes could be charged under constant current conditions at rates as high as 150 C (300 $mA^2$). The high rate of charge was accompanied by a considerable evolution of heat at the electrode, and the charging process was generally terminated by the boiling of the electrolyte. Low rates of charge in the same system below 60 $mA^2$ led to the formation of silver chloride films which could not be discharged efficiently.

4447 PHASE DIAGRAM OF SYSTEM LICL--KCL--$CACRO_4$. Clark, R.P.; Blucher, R.L.; Goldsmith, H.J. (Sandia Labs., Albuquerque, NM). J. Chem. Eng. Data; 14: No. 4, 465-470(Oct 1969).

The phase diagram was determined for the system LiCl--KCl--$CaCrO_4$. Binary eutectics were located at 60 wt % KCl--40 wt % $CaCrO_4$ (mp 651 C) and 62 wt % LiCl--38 wt % $CaCrO_4$ (m 638 C); ternary eutectic was found at 41 wt % LiCl--50 wt % KCl-- 9 wt % $CaCrO_4$ (mp 342 C). It was verified by x-ray diffraction that LiCl--KCl--$CaCrO_4$ is stable diagonal section in quaternary reciprocal system K, Li, $CaCrO_4$, Cl. The salt mixture LiCl--KCl--$CaCrO_4$, is electrolyte--depolarizer combination used in thermal cells (voltaic cells employing molten salt electrolyte).

4448 POLARIZATION OF PARTLY WETTED POROUS ELECTRODES. Ruetschi, P. (ESB Inc., Yardley, PA); Ockerman, J.B. J. Electrochem. Soc.; 116: No. 9, 1222-1227(Sep 1969).

LEAD-ACID BATTERIES;POLARIZATION;ELECTRODES; HYDROGEN;OXYGEN;MATHEMATICAL MODELS;DIFFUSION; ELECTROLYTES;FILMS;IONIZATION;ELECTRIC POTENTIAL;SEALS

4449 INTEGRAL ELECTRONIC CHARGE CONTROLS FOR HIGH PERFORMANCE SECONDARY BATTERIES. Sparks, R.H. (TRW Systems, Redondo Beach, CA); Wright, W.H. IEEE Trans. Aerosp. Electron. Syst.; AES-5: No. 5, 789-797(Sep 1969).

BATTERY CHARGERS;BATTERY CHARGING;CONTROL SYSTEMS;ELECTRONIC CIRCUITS;SPECIFICATIONS

4450 INFLUENCE OF HEAT TREATMENT OF IRON ON ITS BEHAVIOR IN THE ELECTRODES OF ALKALINE STORAGE CELLS. Nikiforova, Yu.A.; Batrakov, V.V.; Iofa, Z.A. Zh. Prikl. Khim.; 42: No. 9, 2133-2135(Sep 1969). (In Russian).

IRON-NICKEL BATTERIES;ELECTRODES;SINTERING; POLARIZATION;HEAT TREATMENTS;PERFORMANCE;HIGH TEMPERATURE;IRON

4451 VISCOSITY, DENSITY, AND ELECTRICAL CONDUCTIVITY OF AQUEOUS NAOH SOLUTIONS AT LOW TEMPERATURES. Baron, N.M. (Leningrad Tech. Inst.); Scherba, M.U. Zh. Prikl. Khim.; 42: No. 9, 2128-2131(Sep 1969). (In Russian).

ELECTRIC BATTERIES;ELECTRODES;SODIUM HYDROXIDES;VISCOSITY;ELECTRIC CONDUCTIVITY;LOW TEMPERATURE;MEDIUM TEMPERATURE;DENSITY

4452 INFLUENCE OF ULTRASOUND AND OF OTHER PRECIPITATION CONDITIONS ON THE PARTICLE-SIZE COMPOSITION OF NICKELOUS HYDROXIDE PRECIPITATES. Kukoz, F.I. (Polytechnic Inst., Moscow); Feigina, E.M. Zh. Prikl. Khim.; 42: No. 9, 1978-1983(Sep 1969). (In Russian).

ELECTRIC BATTERIES;ELECTRODES;NICKEL HYDROXIDES;FABRICATION;ULTRASONIC WAVES; PRESSING;PARTICLE SIZE;PRECIPITATION;KHZ RANGE 01-100;STIRRING;BUBBLES;CAVITATION;NICKEL-CADMIUM BATTERIES;NICKEL-ZINC BATTERIES;IRON-NICKEL BATTERIES

4453 REQUIREMENTS FOR BATTERY ROOMS HOUSING LEAD--ACID STORAGE BATTERIES. Corbett, C.J. J. Inst. Heat. Vent. Eng.; 37: 125-126, 140(Sep 1969).

*LEAD-ACID BATTERIES;STORAGE;BUILDINGS;* HEATING;VENTILATION;HYDROGEN;GASES

4454 EFFECTS OF GAMMA RADIATION ON THE BEHAVIOR OF NICKEL AND CADMIUM ELECTRODES. Argue, G.R. (General Telephone and Electronics Labs., Inc., Bayside, NY); Recht, H.L.; Arcand, G.M. J. Electrochem. Soc.; 116: No. 8, 1164-1166(Aug 1969).

GAMMA RADIATION;CHEMICAL RADIATION EFFECTS; HYDROXIDES;NICKEL-CADMIUM BATTERIES;ELECTRODES; CATHODES;NICKEL-HYDROGEN BATTERIES;NICKEL-ZINC BATTERIES;SILVER-CADMIUM BATTERIES;ANODES

4455 ELECTRICAL PROPERTIES OF ELECTRODEPOSITED $PBO_2$ FILMS. Mindt, W. (Bell Telephone Labs., Inc., Murray Hill, NJ). J. Electrochem. Soc.; 116: No. 8, 1076-1080(Aug 1969).

LEAD-ACID BATTERIES;CATHODES;LEAD OXIDES; ELECTRIC CONDUCTIVITY;ELECTRICAL PROPERTIES; HALL EFFECT

4456 DECOMPOSITION OF AGO IN ALKALINE SOLUTIONS. Tvarusko, A. (ESB, Inc., Yardley, PA). J. Electrochem. Soc.; 116: No. 8, 1070-1075(Aug 1969).

SILVER OXIDES;GASES;OXYGEN;ELECTRIC BATTERIES;HYDROXIDES;ELECTRODES;DECOMPOSITION; GASES;TIME DEPENDENCE;TEMPERATURE DEPENDENCE; PRESSURE DEPENDENCE;POROSITY;ADDITIVES;SODIUM HYDROXIDES;SILVER-ZINC BATTERIES;SILVER-CADMIUM BATTERIES;CATHODES

4457 ANODIC BEHAVIOR OF ZINC IN POTASSIUM HYDROXIDE SOLUTION. Hampson, N.A. (Loughborough Univ. of Tech., Leicestershire, Eng.); Shaw, P.E.; Taylor, R.T. Br. Corros. J.; 4: No. 4, 207-211(Jul 1969).

ELECTRIC BATTERIES;SILVER-ZINC BATTERIES; NICKEL-ZINC BATTERIES;ZINC-MANGANESE BATTERIES; ZINC-AIR BATTERIES;ZINC-CHLORINE BATTERIES; ANODES;POTASSIUM HYDROXIDES;ZINC OXIDES; SOLUBILITY;ZINCATES;HYDROXIDES;PASSIVATION; ELECTRIC CONDUCTIVITY;CHEMICAL REACTION KINETICS

4458 DEVELOPMENTS IN APPLICATION OF OXYGEN-ION CONDUCTING SOLID ELECTROLYTES. Baukal, W. (Battelle Inst., Frankfurt am Main). Chem.-Ing.-Tech.; 41: No. 14, 791-798(Jul 1969). (In German).

SOLIDS;ELECTROLYTES;OXYGEN IONS;MASS TRANSFER;ZIRCONIUM OXIDES;CALCIUM OXIDES; MAGNESIUM OXIDES;YTTRIUM OXIDES;RARE EARTH COMPOUNDS;OXIDES;HIGH TEMPERATURE; *ELECTROCHEMICAL CELLS;MOLTEN SALTS;HIGH-TEMPERATURE FUEL CELLS*

4459 PERFORMANCE OF NONLAMINATED IRON PLATES IN ALKALINE STORAGE CELLS. Lamedman, E.M.; Shapot, M.B.; Novakovskii, A.M. Zh. Prikl. Khim.; 42: No. 7, 1586-1592(Jul 1969). (In Russian).

IRON-NICKEL BATTERIES;ANODES;POROSITY; PERFORMANCE;HYDROXIDES

4460 MICROSTRUCTURE OF SINTERED SILVER ELECTRODES. I AND II. Wales, C.P. (Naval Research Lab., Washington, DC). J. Electrochem. Soc.; 116: No. 6, 729-734(12 Jun 1969).
Higher electrode capacity maintained at higher current densities. SILVER-CADMIUM BATTERIES;SILVER-ZINC BATTERIES;MICROSTRUCTURE; SINTERED MATERIALS;CATHODES;CURRENT DENSITY; PERFORMANCE

4461 CAPACITIES OF ZINC--POTASSIUM HYDROXIDE INTERFACES. Myers, R.A. (Univ. of Maryland, College Park); Marchello, J.M. J. Electrochem. Soc.; 116: No. 6, 790-796(Jun 1969).
ANODES;ZINC-AIR BATTERIES;POTASSIUM HYDROXIDES;MEDIUM TEMPERATURE;INTERFACES; ELECTRICAL PROPERTIES

4462 ELECTROCHEMICAL BEHAVIOR OF ZINC IN ALKALINE MEDIA. Elder, J.P. (Metals and Controls, Inc., Attleboro, MA). J. Electrochem. Soc.; 116: No. 6, 757-762(Jun 1969).
There is strong evidence of the increasing predominance of rechargeable alkaline battery systems. Within this field, there is an ever-increasing interest in the use of zinc as the favored anode material. One of the main disadvantages in the use of zinc as the negative electrode in silver--zinc and nickel--zinc cells lies in the fact that zinc hydroxide is highly soluble in the strongly alkaline aqueous electrolytes employed in these systems. Impedance data have been employed to support the conclusion that the kinetically controlling stage in the zinc dissolution is the rate of diffusion of zinc atoms through the thickening oxide film. It would appear that the cathodic behavior of passivated zinc is dependent not only on the prior anodic history of the electrode, but also on the nature of the electrolyte.

4463 USE OF STEREOMETRIC METALLOGRAPHY FOR DETERMINATION OF STRUCTURAL CHARACTERISTICS OF POROUS NICKEL BODIES FOR ALKALINE STORAGE CELL PLATES. Kukoz, F.I. (Polytechnical Inst., Moscow); Mityagina, Z.I.; Skalozubov, M.F.; Chebakov, V.D. Zh. Prikl. Khim.; 42: No. 4, 800-804(Apr 1969). (In Russian).
NICKEL-CADMIUM BATTERIES;ELECTRODES;SINTERED MATERIALS;METALLOGRAPHY;HYDROXIDES;POROSITY; NICKEL-ZINC BATTERIES;IRON-NICKEL BATTERIES; ELECTRIC BATTERIES;NICKEL;CATHODES

4464 ECONOMICAL FUEL CELL. Frysinger, G.R. (US Army Electronics Command, Fort Monmouth, NJ). IEEE Spectrum; 6: No. 3, 83-90(Mar 1969).
FUEL CELLS;USES;BATTERY CHARGERS;BATTERY CHARGING;ECONOMICS;HYBRID SYSTEMS;ELECTRIC BATTERIES

4465 THERMODYNAMIC PROPERTIES OF SOLID ELECTROLYTE $RBAG_4I_5$. Wiedersich, H. (North American Rockwell Corp.; Thousand Oaks, CA); Johnston, W.V. J. Polym. Sci.; 30: No. 3, 475-482(Mar 1969).
ELECTRIC BATTERIES;ELECTROLYTES;RUBIDIUM IODIDES;SILVER IODIDES;THERMODYNAMIC PROPERTIES; ENTROPY;SPECIFIC HEAT;SILVER IONS

4466 BATTERY ELECTRODE. (to General Motors Corp.). British Patent 1,143,868. 26 Feb 1969. Priority date 16 May 1966, United States of America (USA). vp.
$Li/LiCl/Cl_2$; patent. LITHIUM-CHLORINE BATTERIES;LITHIUM CHLORIDES;CATHODES;BERYLLIUM OXIDES;GRAPHITE

4467 CONTROLLED CURRENT DEPOSITION OF ZINC FROM ALKALINE SOLUTION. Arouete, S.; Blurton, K.F.; Oswin, H.G. (Leesona Moos Labs., Great Neck, NY). J. Electrochem. Soc.; 116: No. 2, 166-169(Feb 1969).
Electrodeposition of zinc onto foil electrodes from alkaline zincate solutions with direct current results in dendritic or black, porous solutions with direct current results in dendritic or black, porous mossy deposits. Smoother deposits are obtained with a pulsed current source or periodic reversal of current. The nature of the deposit with obtained pulsed charging depends on current density, amount of charge passing through electrolytic cell, on time, and off time; optimum values of these parameters are dependent on cell geometry. The results are relevant to secondary silver/zinc batteries.

4468 BATTERY CELL. (to Leesona Corp.). British Patent 1,138,468. 1 Jan 1969. Priority date 25 Jan 1965, United States of America (USA). vp.
Patent; air- or oxygen-depolarized cathode. METAL-GAS BATTERIES;AIR;OXYGEN;CATHODES;DESIGN; TEFLON

4469 SUBSTITUTED ALIPHATIC POLYBENZIMIDAZOLES AS MEMBRANE SEPARATOR MATERIALS. Trischler, F.D. (Whittaker Corp., San Diego, CA); Levine, H.H. J. Appl. Polym. Sci.; 13: No. 1, 101-106(Jan 1969).
SILVER-ZINC BATTERIES;SPACE VEHICLES;BATTERY SEPARATORS;STERILIZATION;ELECTRIC CONDUCTIVITY; ORGANIC COMPOUNDS;BENZIMIDAZOLES

4470 $PBO_2$ IN LEAD--ACID CELL. I. Burbank, J. (Naval Research Lab., Washington, DC); Ritchie, E.J. J. Electrochem. Soc.; 116: No. 1, 125-130(Jan 1969).
Fabrication. LEAD-ACID BATTERIES;LEAD OXIDES; CATHODES;FABRICATION;X-RAY DIFFRACTION;CIRCULAR CONFIGURATION

4471 APPLICATION OF BENCH TESTS IN THE DEVELOPMENT OF HEAT-STERILIZABLE BATTERY SEPARATORS. von Hartmann, W. (Jet Propulsion Lab., Calif. Inst. Tech., Pasadena, CA). pp 715-20 of Proceedings of the 4th Intersociety Energy Conversion Engineering Conference, September 22-26, 1969, Washington, DC. New York; American Institute of Chemical Engineers (1969).
From 4. intersociety energy conversion engineering conference; Washington, District of Columbia, USA (21 Sep 1969).
Polybenzimidazoles, ethylene-acrylic acid copolymer, zirconium oxide and binder on polypropylene mesh, 2-vinylpyridine-methylmethacrylate copolymer, polyethylene, cellophane, teflon. BATTERY SEPARATORS;SPACE VEHICLES;TESTING;STERILIZATION;HEATING;ORGANIC POLYMERS;ELECTRIC BATTERIES;TEFLON; POLYETHYLENES

4472 DEMAND PULSE CHARGING FOR NICKEL--CADMIUM BATTERIES. Gladstone, B.; Newman, B. (Gulton Industries, Inc.). pp 56-9 of Proceedings of 23rd Annual Power Sources

Conference, Fort Monmouth, NJ, 20-22 May 1969. Red Bank, NJ; PSC Publications Committee (1969).
From 23. Annual Power Sources Conference. Session on Power Processing; Fort Monmouth, NJ (20-22 May 1969).
NICKEL-CADMIUM BATTERIES;BATTERY CHARGING; PERFORMANCE;LIFETIME;BATTERY CHARGERS;PULSES; ELECTRIC POTENTIAL;TEMPERATURE DEPENDENCE; MEDIUM TEMPERATURE;ELECTRONIC CIRCUITS

4473 HIGH QUALITY ZINC ANODES. Sague, D.M.; Linden, D. (Power Sources Div., Electronics Components Lab., US Army Electronics Command). pp 101-5 of Proceedings of 23rd Annual Power Sources Conference, Fort Monmouth, NJ, 20-22 May 1969. Red Bank, NJ; PSC Publications Committee (1969).
From 23. Annual Power Sources Conference. Session on Zinc--Air Batteries; Fort Monmouth, NJ (20-22 May 1969).
Quality assurance procedures. ZINC-AIR BATTERIES;ZINC;ANODES;QUALITY CONTROL;QUALITY ASSURANCE;PRODUCTION;SAMPLING

4474 CONTROLS FOR CHARGING SECONDARY CELLS. Wilson, A.M.; Trenkler, Y. (Texas Instruments). pp 123-7 of Proceedings of 23rd Annual Power Sources Conference, Fort Monmouth, NJ, 20-22 May 1969. Red Bank, NJ; PSC Publications Committee (1969).
From 23. Annual Power Sources Conference. Session on Secondary Batteries; Fort Monmouth, NJ (20-22 May 1969).
BATTERY CHARGING;NICKEL-CADMIUM BATTERIES; ELECTRONIC CIRCUITS;MEDIUM PRESSURE;ELECTRIC POTENTIAL;MEDIUM TEMPERATURE;CONTROL SYSTEMS; BATTERY CHARGERS;TESTING

4475 DETERMINATION OF THE SURFACE AREA OF BATTERY ELECTRODES. Bird, J.; Feng, H.; Giner, J.; Turchan, M. (Tyco Labs.). pp 146-9 of Proceedings of 23rd Annual Power Sources Conference, Fort Monmouth, NJ, 20-22 May 1969. Red Bank, NJ; PSC Publications Committee (1969).
From 23. Annual Power Sources Conference. Session on Fuze Power Sources; Fort Monmouth, NJ (20-22 May 1969).
ELECTRIC BATTERIES;ELECTRODES;SIZE;SURFACES; LEAD-ACID BATTERIES;SILVER-ZINC BATTERIES; NICKEL-ZINC BATTERIES;SILVER-CADMIUM BATTERIES

4476 EFFECT OF ELECTRODE STRUCTURE ON PERFORMANCE OF POROUS ELECTRODES. Austin, L.G.; Gagnon, E.G. (Dept. Materials Sci., Penn. State Univ.); Piver, W.T. (Dept. Chem. Eng., North Carolina State Univ.). pp 150-3 of Proceedings of 23rd Annual Power Sources Conference, Fort Monmouth, NJ, 20-22 May 1969. Red Bank, NJ; PSC Publications Committee (1969).
From 23. Annual Power Sources Conference. Session on Fuze Power Sources; Fort Monmouth, NJ (20-22 May 1969).
Oriented toward primary $Ag/Ag_2O$ cells. ELECTRIC BATTERIES;SILVER;SILVER OXIDES; ELECTRODES;PERFORMANCE

4477 ZINC--AIR GENERATORS. Saada, A.; Vignaud, M. pp 144-148 of Third international symposium on fuel cells. Brussels; Presses Academiques Europeennes (1969). (In French)
From 3. international symposium on fuel cells; Brussels, Belgium (16 Jun 1969).
See CONF-690671--.
Electrodes were developed whose performance, lifetime, and cost answer specific usage conditions. The use of zinc--air generators in primary or secondary batteries or in mechanically rechargeable batteries is discussed, and their characteristics are given.

4478 DISPERSE CATALYST GENERATORS. Bonnemay, M.; Bronoel, G.; Daul, M.; Doniat, D. (CNRS, Bellvue, France). pp 247-252 of Third international symposium on fuel cells. Brussels; Presses Academiques Europeennes (1969). (In French)
From 3. international symposium on fuel cells; Brussels, Belgium (16 Jun 1969).
See CONF-690671--.
The use of dispersed electrodes was studied for the development of fuel cells and batteries. The characteristics of a new battery with a dispersed positive electrode are reported.

4479 DEVELOPMENTS IN ALTERNATOR SYSTEMS FOR VEHICLES. Winkley, A.W. (Joseph Lucas (Electrical) Ltd., Birmingham, Eng.). Proc. Inst. Mech. Eng. (London); 184: vp(1969).
BATTERY CHARGERS;ALTERNATORS;REVIEWS; VEHICLES

4480 CHOICE OF ALTERNATOR OR DYNAMO. Jenkinson, R.A. (Joseph Lucas (Electrical) Ltd., Birmingham, Eng.). Proc. Inst. Mech. Eng. (London); 184: 1-5(1969).
A general case for the change from dynamos to alternators has been presented. This rests on the need to improve generator performance to combat worsening traffic conditions together with rising electrical loads. Greater scope for development is seen to exist in the alternator than in the dynamo. The present application for the dynamo lies only with small vehicles of low engine capacity.

4481 DISPERSED-CATALYST ELECTRODES FOR FUEL CELLS AND BATTERIES. Bonnemay, M.; Bronoel, G.; Daul, M.; Doniat, D. (CNRS, Bellevue, France). pp 247-252 of Journees Int. Etude Piles Combust., C.R., 3rd. Brussels; Presses Acad. Eur. (1969). (In French)
Circulating the catalyst as a suspension yields better diffusion of gas to electrode. A hydrogen fuel cell yielded 100 $mA/cm^2$ at 0.6 V and $40^0$, and a cadmium/air battery produced 1.0 V for 70 Wh/kg. (RWR)

4482 LEAD--ANTIMONY--CADMIUM ALLOYS FOR BATTERY GRIDS. Bagshaw, N.E. (Electric Power Shortage Ltd., Swinton, Eng.). pp 209-220 of Third international conference on lead. Dunlop, R.H. (ed.). Oxford; Pergamon Press (1969).
Pb--2Sb--2Cd pseudo-binary alloys (4 to 5% of the intermetallic compound SbCd) were found to perform well, especially in those types of batteries where charge retention is important, as in aircraft standby batteries. (RWR)

4483 CHANGES IN MICROSTRUCTURE OF SINTERED SILVER ELECTRODE AFTER REPEATED CYCLING AT LOW CURRENT. Wales, C.P.; Simon, A.C. J. Electrochem. Soc.; 115: No. 12, 1228-1236(Dec 1968).
SILVER-ZINC BATTERIES;CATHODES;SILVER; MICROSTRUCTURE;SINTERED MATERIALS

4484 AUTORADIOGRAPHIC RECORDING OF PARTIALLY DISCHARGED NEGATIVE GRID PLATES OF LEAD STORAGE BATTERIES. Euler, K.J. (Varta AG, Frankfurt am Main). Electrochim. Acta; 13: No. 12, 2245-2246(Dec 1968). (In German).

LEAD-ACID BATTERIES;AUTORADIOGRAPHY;SULFATES; ELECTRIC CURRENTS;ANODES;CATHODES;GRIDS;SULFUR 35;SPATIAL DISTRIBUTION

4485 NEGATIVE ELECTRODE IN GAS-TIGHT ALKALINE STORAGE BATTERIES. Kraemer, G. (Varta GmbH, Hagen, Ger.). Electrochim. Acta; 13: No. 12, 2237-2244(Dec 1968). (In German).
ELECTRIC BATTERIES;ANODES;HYDROXIDES; DIMENSIONS;BATTERY CHARGING;SEALS

4486 FABRICATING ZINC OXIDE ELECTRODES FOR SECONDARY BATTERIES. Mathur, P.B.; Karuppannan, N.G. (to Council of Scientific and Industrial Research, India). Indian Patent 103,972. 23 Nov 1968. Filed date 21 Feb 1966. 8p.
ZINC OXIDES;ELECTRIC BATTERIES;PRESSING; SILVER;ZINC;PLATES;ELECTRODES;FABRICATION

4487 RAPID DETERMINATION OF IRON IN HIGHLY REDUCED ACTIVE MATERIAL IN IRON PLATES OF ALKALINE STORAGE BATTERIES. Kukoz, F.I. (Novocherkassk Polytechnic Inst., USSR); Makarov, V.I.; Sannikov, N.I. Zh. Prikl. Khim.; 41: No. 11, 2435-2440(Nov 1968). (In Russian).
HYDROXIDES;IRON;MAGNETITE;MAGNETIC SUSCEPTIBILITY;QUALITATIVE CHEMICAL ANALYSIS; REDUCTION;IRON-NICKEL BATTERIES;PLATES

4488 PREPARATION AND STRUCTURE OF ELECTRODEPOSITED SPONGE CADMIUM ELECTRODES. Henderson, I.H.S.; Ladan, S.G. Can. J. Chem. Eng.; 46: 355-361(Oct 1968).
CADMIUM;ELECTRODEPOSITION;FABRICATION; SUBSTRATES;CADMIUM CHLORIDES;SOLUTIONS; POTASSIUM CHLORIDES;PERFORMANCE;ECONOMICS; ELECTRIC BATTERIES;ELECTRODES;NICKEL-CADMIUM BATTERIES;SILVER-CADMIUM BATTERIES;ANODES

4489 ELECTROLYTIC SINTERING OF NICKEL POWDER. Henderson, I.H.S.; Ladan, S.G. Can. J. Chem. Eng.; 46: 361-363(Oct 1968).
NICKEL-CADMIUM BATTERIES;CATHODES;NICKEL; ELECTRODEPOSITION;SULFATES;CHLORIDES; FLUOROBORATES;SULFAMIC ACID;SINTERING;POWDERS; HYDROXIDES;SUBSTRATES;POWDER METALLURGY; ELECTROCHEMISTRY;NICKEL COMPOUNDS

4490 METALS: KEY TO BATTERY-POWERED AUTO. Ragone, D.V. Mater. Eng.; 68: No. 4, 34-36(Oct 1968).
METALS;MATERIALS;SODIUM-SULFUR BATTERIES; MOLTEN SALTS;ELECTROLYTES;ORGANIC COMPOUNDS; NICKEL-ZINC BATTERIES;METAL-GAS BATTERIES; ELECTRIC BATTERIES;COMPARATIVE EVALUATIONS; ELECTRIC-POWERED VEHICLES;AUTOMOBILES;AIR

4491 BEHAVIOR OF DIMETHYL SULFITE AS POTENTIAL NONAQUEOUS BATTERY SOLVENT. Yao, N.P. (Univ. of California, Los Angeles); D'Orsay, E.; Bennion, D.N. J. Electrochem. Soc.; 115: No. 10, 999-1003(Oct 1968).
ELECTRIC BATTERIES;ELECTROLYTES;ELECTRIC CONDUCTIVITY;SULFONIC ACID ESTERS;SODIUM COMPOUNDS;ORGANIC FLUORINE COMPOUNDS;SULFITES; VISCOSITY;DENSITY

4492 COULOGRAVIMETRIC INVESTIGATION OF ZINC ELECTRODE IN POTASSIUM HYDROXIDE. Langer, A. (Westinghouse Research Labs., Pittsburgh); Pantier, E.A. J. Electrochem. Soc.; 115: No. 10, 990-993(Oct 1968).
POTASSIUM HYDROXIDES;ZINC;PASSIVATION; QUANTITY RATIO;ELECTROLYTES;ELECTRIC BATTERIES; ELECTRODES;SILVER-ZINC BATTERIES;NICKEL-ZINC BATTERIES;ZINC-MANGANESE BATTERIES;ZINC-AIR BATTERIES;ZINC-CHLORINE BATTERIES;ANODES

4493 POTENTIOSTATIC FORMING OF POSITIVE LEAD ELECTRODES. Bogenschuetz, A.F.; Glaser, H.W.; Marzel, O. Electrochim. Acta; 13: No. 10, 2013-2019(Oct 1968). (In German).
LEAD-ACID BATTERIES;CATHODES;MATERIALS WORKING;LEAD OXIDES;FABRICATION

4494 ANALYSIS OF VOLTAGE-LIMITED BATTERY CHARGING SYSTEMS. Bacher, J.; Rusta, D. IEEE Trans. Aerosp. Electron. Syst.; AES-4: No. 5, 792-798(Sep 1968).
4 Ah. BATTERY CHARGERS;SPACE VEHICLES; ELECTRIC BATTERIES;PERFORMANCE;OPERATION

4495 DETERMINATION OF PARAMETERS OF EQUIVALENT ELECTRODE CIRCUITS. Novosel'skii, I.M. Sov. Electrochem. (Engl. Transl.); 4: No. 9, 971-977(Sep 1968).
Translated from Elektrokhimiya; 4: No. 9, 1077-1085(Sep 1968).
ELECTRIC BATTERIES;ELECTRODES; ELECTROCHEMISTRY;EQUIVALENT CIRCUITS;IMPEDANCE; CHEMICAL REACTION KINETICS

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SPACECRAFT POWER SUPPLIES;REVIEWS; PHOTOVOLTAIC CELLS;FUEL CELLS;THERMOELECTRICITY; CRYOGENICS;ORIENTATION;HEAT TRANSFER; ELECTROLYSIS;ELECTRIC BATTERIES;ENERGY CONVERSION;MAGNETOHYDRODYNAMICS;THERMIONIC CONVERTERS;SOLAR RADIATION

4829 (AD--484913L) POWER FOR ARCTIC RESEARCH. Russell, C.R. (General Motors Corp., Santa Barbara, Calif. (USA). Defense Research Labs.). Apr 1966. 12p. DDC.
Fuel cells, gas turbines, thermoelectric generators, batteries, and nuclear sources. FUEL CELLS;GAS TURBINES;THERMOELECTRIC GENERATORS;ELECTRIC BATTERIES;RADIOISOTOPE BATTERIES;ARCTIC REGIONS;USES;POWER SUPPLIES; COMPARATIVE EVALUATIONS;REVIEWS

4830 (AD--607425) PROCEEDINGS OF 14TH ANNUAL POWER SOURCES CONFERENCE, 17--19 MAY 1960. (Army Electronics Labs., Fort Monmouth, N.J. (USA)). May 1960. 162p.
SOLAR ENERGY CONVERSION;FUEL CELLS;ELECTRIC BATTERIES;MEETINGS

4831 (AD--610104) INVESTIGATION OF POWER SOURCES FOR MANPACK EQUIPMENT. FINAL TECHNICAL REPORT FOR 24 FEB-24 AUG 1964. Hovious, T.C. (General Electric Co., Lynn, Mass. (USA)). Dec 1964. Contract AF-30-602-3356. 201p. (RADC-TDR--64-412). NTIS.
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4832 (AD--615883) ELECTRIC MOTOR CARS. Hoffman, G.A. (Rand Corp., Santa Monica, Calif. (USA)). Mar 1963. 59p. (RM--3298-FF).
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4833 (AD--637459) ELECTRIC FORKLIFT TRUCKS OF 2,000-, 4,000-, AND 6,000-POUND CAPACITY. (Pittsburgh Univ., Washington, D.C. (USA). Research Staff). Jul 1966. Contract DA-49-186-AMC-214(D). 12p. NTIS.
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4834 (AD--666773) POWER SOURCES FOR ELECTRIC CARS. TECHNICAL REPORT. Frysinger, G.R. (Army Electronics Command, Fort Monmouth, N.J. (USA)). Jan 1968. 42p. (ECOM--2929). NTIS.
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SOLAR ENERGY CONVERSION;FUEL CELLS;ELECTRIC BATTERIES;MEETINGS

4836 (AD--699351) NO-BREAK, 1.5-KW, DIRECT-CURRENT, 22- TO 28-VOLT POWER SUPPLY. Lange, G.M. (Army Mobility Equipment Research and Development Center, Fort Belvoir, Va. (USA)). Sep 1969. 27p. (USAMERDC--1963). NTIS $6.00.
Alternator--battery combination with lead--acid batteries. POWER SUPPLIES;LEAD-ACID BATTERIES;DIRECT CURRENT;ALTERNATORS; PERFORMANCE;RELIABILITY;DESIGN;USES;BATTERY CHARGERS

4837 (AD--717950) SOME DEEP SEA VEHICLE PERSONNEL HULLS AND ENERGY STORAGE SUBSYSTEMS. Heronemus, W.E.; Kidd, G.R. (Massachusetts Univ., Amherst (USA)). Nov 1970. 95p. NTIS $3.00.
LEAD-ACID BATTERIES;SILVER-ZINC BATTERIES; COMPARATIVE EVALUATIONS;SUBMARINES;USES

4838 (AD--719099) ELECTRICAL POWER REQUIREMENTS. FINAL REPORT ON MATERIAL TEST PROCEDURE. (Army Test and Evaluation Command, Aberdeen Proving Ground, Md. (USA)). Dec 1970. 12p. (MTP--6-3-517). NTIS.
RADIO EQUIPMENT POWER SUPPLIES;ELECTRIC BATTERIES;FUEL CELLS;ELECTRIC GENERATORS; PERFORMANCE TESTING

4839 (AD--740210) RESEARCH ON ELECTROCHEMICAL ENERGY CONVERSION SYSTEMS. REPORT NO. 12 (FINAL). Foley, R.T.; Bomkamp, D.H.; Thompson, C.D. (American Univ., Washington, D.C.). Jan 1972. Contract DA-44-009-AMC-1386(T). 63p. NTIS.
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4841 (AD--877701) ELECTRIC DRIVE FOR VEHICLES. ANNOTATED BIBLIOGRAPHY FROM 1965 TO 1968. Alkema, J. (Ministerie van Defensie, The Hague (Netherlands). Technisch Documentatie en Informatie Centrum voor de Krijgsmacht). Jan 1969. 34p. (Abstracts in English, Dutch, German, and French). (TDCK--52578). NTIS.
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4843 (AD--905126L) INITIAL PRODUCTION TEST OF TRUCK, FORKLIFT, 2000-POUND, ELECTRIC-MOTOR-DRIVEN, SOLID-RUBBER-TIRED. FINAL REPORT, 13 MAR-26 JUN 1972. Hines, R.T.; Nixon, H.L.; Kilde, S.T. (Air Force Materials Lab., Wright-Patterson AFB, Ohio (USA)). Aug 1972. 111p. (APG-MT--4135). DDC.
ELECTRIC-POWERED VEHICLES;PERFORMANCE; OPERATION;MAINTENANCE;MOTORS;ELECTRIC BATTERIES; USES

4844 (AD--908298L) MESSERSCHMITT ELECTRICAL VEHICLES. (Foreign Technology Div., Wright-Patterson AFB, Ohio (USA)). Feb 1973. 11p. (FTD-HC--23-1728-72). DDC.
Edited translation of Messerschmitt-Boelkow-Blohm, 1-6(1971).
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4845 (AD--909005L) CURRENT STATE OF DEVELOPMENT OF THE ELECTRIC AUTOMOBILE. Oehms, K.J. (Army Foreign Science and Technology Center, Charlottesville, VA). Jan 1973. 11p. (FSTC-HT--23-1222-72). DDC.
Translation of Deutsches Electrohandwerk (W. Germany), 24: No. 22(1971).
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4846 (AD--911579L) ELECTRICAL TRANSPORTER MADE OF PLASTIC. (Army Foreign Science and Technology Center, Charlottesville, VA). Jun 1972. 3p. (FSTC-HT--23-625-72). DDC.
Translated from Logistik, Technik und Versorging by Klevenow.
ELECTRIC-POWERED VEHICLES;MOTORS;ORGANIC POLYMERS;ELECTRIC BATTERIES;PERFORMANCE;USES

4847 (AD--912002L) ELECTRIC ENGINE AND ITS GENERATORS. Benezech, J. (Army Foreign Science and Technology Center, Charlottesville, VA). Aug 1972. 47p. (FSTC-HT--23-2360-72). DDC.
Translation of Ingenieurs de l'Automobile (France), 281-306(May 1971).
Overview. ELECTRIC-POWERED VEHICLES;ELECTRIC BATTERIES;MOTORS;POWER SUPPLIES;ELECTROLYTES; TRANSISTORS;ELECTRONIC CIRCUITS;DIAGRAMS; REVIEWS

4848 (AD--915740L) QUIET AUTOMOBILES OF THE

FUTURE. (Army Foreign Science and Technology Center, Charlottesville, VA). Sep 1972. 6p. (FSTC-HT--23-2242-72). DDC.
Translated from VDI Nachrichten (W. Germany), No. 13, 29 Mar 1972.
Fe/air. ELECTRIC-POWERED VEHICLES;ECONOMICS; METAL-GAS BATTERIES;COST;LEAD;SULFUR;IRON;AIR

4849 (AD--919478L) DEVELOPMENT OF THE E1-BILEN NORWEGIAN ELECTRIC VEHICLE. Hartmann, S. (Army Foreign Science and Technology Center, Charlottesville, VA). May 1973. 9p. (FSTC-HT--23-1318-73). DDC.
Translation of Teknisk Ukeblad Teknikk (Norway), No. 43, 93-4(1972).
ELECTRIC BATTERIES;ELECTRIC-POWERED VEHICLES; NORWAY;ELECTRIC MOTORS;RANGE;DISTANCE;COST; ALUMINIUM;GLASS

4850 (AD--920346L) ELECTRIC BATTERY IN ITS INFANCY. Galli, R. (Army Foreign Science and Technology Center, Charlottesville, VA). Nov 1973. 14p. (FSTC-HT--23-1440-71). DDC.
Translation of Sapere - Marzo (Italy), 28-33(1971).
Research status. ELECTRIC-POWERED VEHICLES; ELECTRIC BATTERIES;FUEL CELLS;ITALY;RESEARCH PROGRAMS

4851 (AD-A--031704) SUPERCONDUCTING MOTORS AND LITHIUM-WATER BATTERIES FOR TORPEDO PROPULSION. TECHNICAL NOTE. Johnson, A.W. (Defence Research Establishment, Ottawa, Ontario (Canada)). Jul 1976. 14p. (DREO-TN--76-18). Dep. NTIS, PC A02/MF A01.
Presently-available information suggests that the performance of the MK 37 torpedo could be improved by the use of a superconducting electric motor powered by a lithium-seawater battery. Details are given and recommendations for future work are described.

4852 (AD-A--036458) ELECTRIC VEHICLE RESEARCH, DEVELOPMENT AND TECHNOLOGY-FOREIGN. Busi, J.D. (Defense Intelligence Agency, Washington, D.C. (USA)). Apr 1976. 73p. (DST--1850S-403A-75). NTIS PC A04/MF A01.
Current research efforts and a computer analysis of foreign electrochemical traction battery technology utilizing various standardization and simulation techniques support the following ranking of foreign electric vehicle technology: United States, United Kingdom; Japan; Federal Republic of Germany; USSR; France; Italy; and Sweden. All-electric vehicle systems (battery-battery or battery-fuel cells) are not presently competitive, on an energy or power density basis, with conventional, fossil-fueled, internal combustion engine systems. All-electric vehicle systems, however, offer an alternate or complementary mode of transportation in major metropolitan areas by reducing atmospheric pollution and fossil fuel consumption. Advanced lead-acid, nickel-iron, and nickel-zinc traction batteries offer the greatest promise for urban transit vehicles(city buses, microbuses, and commuter cars). Commercial application of these electrochemical propulsion systems will receive considerable government and public support over the next 10 years in Europe, Japan, and the USSR. High-energy electrochemical propulsion systems such as the sodium-sulfur, lithium-sulfur, and metal-air traction battery systems are theoretically promising. Actual utilization of these power sources in small military and domestic vehicles is anticipated by the late 1980s.

4853 (ANL--76-8, pp A.2-A.18) SECONDARY BATTERIES FOR LOAD LEVELING. Birk, J.R.; Kalhammer, F.R. (Electric Power Research Inst., Palo Alto, CA). 1976.
From Battery workshop; Argonne, Illinois, USA (21 Mar 1976).
Proceedings of the symposium and workshop on advanced battery research and design, March 22--24, 1976.
More than fifty years ago, secondary batteries were used advantageously to store and deliver electric energy for electric rail and city emergency power systems. Today, batteries are being considered seriously for storage of off-peak energy because they promise a possibly unique combination of favorable operational characteristics, flexible siting, and environmental compatibility. These prospects have given rise to broad and growing activities in research, development, and engineering of advanced battery concepts and systems for utility energy storage. The technical and cost criteria for utility energy storage are briefly discussed here. Candidate battery systems are reviewed in terms of their characteristics and basic prospects to meet utility criteria. The question of the technoeconomic feasibility of lead--acid batteries for utility energy storage is also examined. Significant technical and economic obstacles on the way to practical utility batteries are identified and related to the major ongoing development efforts. 3 figures, 5 tables.

4854 (ANL--76-8, pp A.19-A.33) SECONDARY BATTERIES FOR ELECTRIC VEHICLES. Landgrebe, A.R. (Energy Research and Development Administration, Washington, DC). 1976.
From Battery workshop; Argonne, Illinois, USA (21 Mar 1976).
Proceedings of the symposium and workshop on advanced battery research and design, March 22--24, 1976.
An important part of the Energy Storage Program of the U. S. Energy Research and Development Administration is the development of secondary storage batteries for automotive propulsion applications. The successful development of batteries for this purpose will provide significant savings of oil resource and will also have beneficial environmental effects. Of the battery systems being developed, major efforts are presently or will be concentrated on the following seven systems: advanced lead--acid, nickel--iron, nickel--zinc, zinc--air, iron--air, lithium--metal sulfide, and sodium--sulfur batteries. The probability that one or more of these systems will meet the technical requirements for the intended application within the next several years appears good. The ultimate technical/economic feasibility of these systems cannot be assessed at this time because many engineering problems must still be resolved. However, the high-temperature systems, Li--MS and Na--S systems, appear to be good candidates for electric vehicles in the long term. 7 tables.

4855 (ANL--76-8, pp A.107-A.128) BATTERY DEVELOPMENT IN JAPAN. Yao, N.P. (Argonne National Lab., IL). 1976.
From Battery workshop; Argonne, Illinois, USA (21 Mar 1976).
Proceedings of the symposium and workshop on advanced battery research and design, March 22--24, 1976.
The main thrust of battery development in Japan is toward application in electric vehicles. Incentives to develop commercial-scale electric vehicles in Japan are the

desires to improve the air and noise quality in big cities, and to secure an international position in the electric vehicle field and thereby expand Japan's economy. Development of advanced battery technology for electric vehicles has been in progress as a part of the National Electric Vehicle Research and Development Project, instituted early in 1971 by the Agency of Industrial Science and Technology, MITI, Japan. Three general types of advanced vehicle batteries are being developed under the national project: lead--acid, metal/air, and sodium/sulfur. Progress has been made in each of the advanced batteries since 1971. Battery performance goals established for 1977, which marks the conclusion of the national project, incorporate an increase of cycle life requirement with reduced specific energy goals. Performance demonstration of the advanced batteries in experimental electric vehicles is expected early in 1977. 12 figures, 4 tables.

4856 (ANL--7958) LITHIUM/SULFUR BATTERIES FOR OFF-PEAK ENERGY STORAGE: A PRELIMINARY COMPARISON OF ENERGY STORAGE AND PEAK POWER GENERATION SYSTEMS. Kyle, M.L.; Cairns, E.J.; Webster, D.S. (Argonne National Lab., Ill. (USA)). Mar 1973. Contract W-31-109-eng-38. 116p. Dep. NTIS $5.45.
ELECTRIC BATTERIES;ECONOMICS;LITHIUM;SULFUR; OFF-PEAK ENERGY STORAGE;COMPARATIVE EVALUATIONS; PUMPED STORAGE;COMPRESSED AIR;HYDROGEN STORAGE; PERFORMANCE

4857 (ANL--8075) NEED FOR DEVELOPMENT OF HIGH-ENERGY BATTERIES FOR ELECTRIC AUTOMOBILES. Nelson, P.A.; Chilenskas, A.A.; Steunenberg, R.K. (Argonne National Lab., Ill. (USA)). Nov 1974. Contract W-31-109-eng-38. 24p. Dep. NTIS $4.00.
ELECTRIC-POWERED VEHICLES;LITHIUM-SULFUR BATTERIES;PLANNING;ECONOMICS;ENVIRONMENT; SPECIFICATIONS

4858 (APTD--0724) FINAL REPORT: HYBRID HEAT ENGINE/ELECTRIC SYSTEMS STUDY. VOLUME I. SECTIONS 1 THROUGH 13. (Aerospace Corp., El Segundo, Calif. (USA). Office of Corporate Planning). 1 Jun 1971. Contract F04701-70-C-0059. vp. (PB--201646(Vol.1)). NTIS $13.00.
HYBRID ELECTRIC-POWERED VEHICLES;HEAT ENGINES;OPERATION;EXHAUST GASES;DESIGN; PERFORMANCE;COMPUTER CALCULATIONS;COST; FEASIBILITY STUDIES;AUTOMOBILES;BUSES;SPARK IGNITION ENGINES;DIESEL ENGINES;GAS TURBINES; RANKINE CYCLE ENGINES;STIRLING ENGINES;LEAD-ACID BATTERIES;NICKEL-CADMIUM BATTERIES;NICKEL-ZINC BATTERIES;ELECTRIC MOTORS;ELECTRIC GENERATORS;EFFICIENCY;WEIGHT

4859 (APTD--0957) EMISSION OPTIMIZATION OF HEAT ENGINE/ELECTRIC VEHICLE. Andon, J.; Barpal, I.R. (Minicars, Inc., Goleta, Calif. (USA)). 28 Jan 1971. 90p. (PB--198093). Dep. NTIS $4.75.
HYBRID ELECTRIC-POWERED VEHICLES;EXHAUST GASES;OPTIMIZATION;HEAT ENGINES;COMPARATIVE EVALUATIONS;MODIFICATIONS;FUEL SYSTEMS; HYDROCARBONS;NITROGEN OXIDES;ELECTRIC MOTORS; MECHANICAL TRANSMISSIONS;ELECTRIC BATTERIES

4860 (BM-BULL--313) PERMISSIBLE STORAGE-BATTERY LOCOMOTIVES AND POWER TRUCKS. Ilsley, L.C.; Gleim, E.J.; Brunot, H.B. (Bureau of Mines, Washington, D.C. (USA)). 1929. 120p. TIC.
ELECTRIC-POWERED VEHICLES;DESIGN;MINING EQUIPMENT;ELECTRIC MOTORS;CONTROL SYSTEMS; ELECTRIC BATTERIES;SAFETY

4861 (BM-IC--6068) DEVELOPMENT AND SAFETY OF THE STORAGE-BATTERY LOCOMOTIVE. Ilsley, L.C. (Bureau of Mines, Washington, D.C. (USA)). 1928. 3p. TIC.
The advantages of storage-battery locomotive over the trolley type in gassy mines are discussed.

4862 (BM-RI--2449) BUREAU OF MINES APPROVAL SYSTEM AS APPLIED TO PERMISSIBLE STORAGE-BATTERY LOCOMOTIVES (FIRST COMPLETE INVESTIGATION UNDER SCHEDULE 15). Ilsley, L.C.; Brunot, H.B. (Bureau of Mines, Washington, D.C. (USA)). 1923. 8p. TIC.
Report covers the inspection and test of a storage-battery locomotive manufactured by the Geo. D. Whitcomb Co., Rochelle, Ill., to which Approval 1500 was assigned.

4863 (BM-TP--264) PRELIMINARY INVESTIGATIONS OF STORAGE-BATTERY LOCOMOTIVES: SPECIFICATIONS, LABORATORY TESTS, PERMISSIBLE SCHEDULE. Ilsley, L.C.; Brunot, H.B. (Bureau of Mines, Washington, D.C. (USA)). 1920. 35p. TIC.
Report deals with the development of specifications for Schedule 15 and gives data to assist those who are developing apparatus to meet the requirements of this schedule.

4864 (COM--74-10101/5) ELECTRIC AUTOMOBILES. A BIBLIOGRAPHY WITH ABSTRACTS. REPORT FOR 1964--NOVEMBER 1973. Ringe, J.W. (National Technical Information Service, Springfield, Va. (USA)). Dec 1973. 42p. (NTIS-WIN--74-002). NTIS $20.00.
The NTISearch bibliography contains 36 selected abstracts of research reports retrieved using the NTIS on-line search system NTISearch. Included are studies of battery systems, emissions, costs and experimental evaluations of electric and hybrid vehicle propulsion.

4865 (COM--74-11573) ELECTRIC AUTOMOBILES. A BIBLIOGRAPHY WITH ABSTRACTS. REPORT FOR 1964--SEPTEMBER 1974. Lehmann, E.J. (National Technical Information Service, Springfield, Va. (USA)). Oct 1974. 76p. (NTIS-WIN--74-082). NTIS $20.00.
Sixty citations. ELECTRIC-POWERED VEHICLES; BIBLIOGRAPHIES;ELECTRIC BATTERIES;AUTOMOBILES; COST;PERFORMANCE

4866 (CONF-691143--) INTERNATIONAL ELECTRIC VEHICLE SYMPOSIUM, PHOENIX, ARIZONA, 5--7 NOVEMBER 1969. (Electric Vehicle Council, New York (USA)). Nov 1969. 560p. Electric Vehicle Council, New York, NY.
From 1. international electric vehicle symposium; Phoenix, Arizona, USA (5 Nov 1969).
54 papers. ELECTRIC-POWERED VEHICLES; MEETINGS;ECONOMICS;DESIGN;ELECTRIC BATTERIES; CONTROL SYSTEMS;ELECTRIC RAILWAYS;BUSES; AUTOMOBILES;RAPID TRANSIT SYSTEMS;RESEARCH PROGRAMS

4867 (CONF-691143--, pp 1-5) GETTING MOVING ELECTRICALLY. Clapp, W.J. Nov 1969.
From 1. international electric vehicle symposium; Phoenix, Arizona, USA (5 Nov 1969). International electric vehicle symposium.
ELECTRIC-POWERED VEHICLES;REVIEWS;ELECTRIC BATTERIES;AUTOMOBILES;MARKET;ELECTRIC RAILWAYS;

RAPID TRANSIT SYSTEMS

4868 (CONF-691143--, pp 6-17) FUTURE OF ELECTRIC TRANSPORTATION. Seifert, W.W. Nov 1969.
From 1. international electric vehicle symposium; Phoenix, Arizona, USA (5 Nov 1969). International electric vehicle symposium.
ELECTRIC-POWERED VEHICLES;FEASIBILITY STUDIES;FORECASTING;TECHNOLOGY ASSESSMENT; ELECTRIC RAILWAYS;AUTOMOBILES;ELECTRIC BATTERIES;MATERIALS;ELECTRIC POWER

4869 (CONF-691143--, pp 24-28) INTERNATIONAL ELECTRIC VEHICLE SYMPOSIUM. Farsje, N.R. Nov 1969.
From 1. international electric vehicle symposium; Phoenix, Arizona, USA (5 Nov 1969). International electric vehicle symposium.
ELECTRIC-POWERED VEHICLES;ELECTRIC BATTERIES; INDUSTRY;AUTOMOBILES;SOCIO-ECONOMIC FACTORS; MARKET

4870 (CONF-691143--, pp 29-32) DIRECTIONS FOR ELECTRIC VEHICLE DEVELOPMENT. George, J.H.B. Nov 1969.
From 1. international electric vehicle symposium; Phoenix, Arizona, USA (5 Nov 1969). International electric vehicle symposium.
ELECTRIC-POWERED VEHICLES;TECHNOLOGY ASSESSMENT;ECONOMICS;SPECIFICATIONS;AUTOMOBILES; POWER;WEIGHT;STORED ENERGY;COST;ELECTRIC BATTERIES;FUEL CELLS

4871 (CONF-691143--, pp 33-45) ECONOMIC IMPACT OF ELECTRIC VEHICLES. Netschert, B.C. Nov 1969.
From 1. international electric vehicle symposium; Phoenix, Arizona, USA (5 Nov 1969). International electric vehicle symposium.
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4872 (CONF-691143--, pp 62-69) PORTABLE ELECTRICITY, PRIME MOVER UNDERGROUND. Buzard, W.W. Nov 1969.
From 1. international electric vehicle symposium; Phoenix, Arizona, USA (5 Nov 1969). International electric vehicle symposium.
COAL MINES;ELECTRIC-POWERED VEHICLES;USES; DESIGN;ELECTRIC BATTERIES;TRANSPORTATION SYSTEMS

4873 (CONF-691143--, pp 74-76) ELECTRIC VEHICLES IN COMMERCE AND INDUSTRY. Leighten, E.H. Nov 1969.
From 1. international electric vehicle symposium; Phoenix, Arizona, USA (5 Nov 1969). International electric vehicle symposium.
ELECTRIC-POWERED VEHICLES;USES;INDUSTRY; TRUCKS;ELECTRIC BATTERIES;BATTERY CHARGERS; CONTROL SYSTEMS

4874 (CONF-691143--, pp 83-84) FUTURE POWER SOURCES FOR OFF-THE-ROAD VEHICLES. Smyth, J.R. Nov 1969.
From 1. international electric vehicle symposium; Phoenix, Arizona, USA (5 Nov 1969). International electric vehicle symposium.
ELECTRIC-POWERED VEHICLES;ELECTRIC BATTERIES; IRON-NICKEL BATTERIES;NICKEL-CADMIUM BATTERIES; SILVER-ZINC BATTERIES;FUEL CELLS;METAL-GAS BATTERIES;LEAD-ACID BATTERIES;STORED ENERGY; COST;USES

4875 (CONF-691143--, pp 85-86) FUTURE POWER SOURCES FOR OFF-THE-ROAD VEHICLES. Willihnganz, E. Nov 1969.
From 1. international electric vehicle symposium; Phoenix, Arizona, USA (5 Nov 1969). International electric vehicle symposium.
ELECTRIC-POWERED VEHICLES;ELECTRIC BATTERIES; TECHNOLOGY ASSESSMENT;INDUSTRY;TRUCKS;LEAD-ACID BATTERIES;IRON-NICKEL BATTERIES;NICKEL-CADMIUM BATTERIES;BATTERY CHARGERS

4876 (CONF-691143--, pp 115-133) SOLID-STATE DC CONTROLLERS FOR ELECTRIC VEHICLES. Putkovich, R.P.; Prines, F.J. Nov 1969.
From 1. international electric vehicle symposium; Phoenix, Arizona, USA (5 Nov 1969). International electric vehicle symposium.
ELECTRIC-POWERED VEHICLES;CONTROL EQUIPMENT; ELECTRIC MOTORS;REGENERATIVE BRAKING; TRANSISTORS;ELECTRONIC CIRCUITS;OPERATION; EFFICIENCY;POWER;TORQUE;ELECTRIC BATTERIES

4877 (CONF-691143--, pp 152-177) ELECTRIC PROPULSION FOR SHORT HAUL COMMERCIAL VEHICLES AND CITY BUSES. Chirgwin, K.M.; Kalman, G.P. Nov 1969.
From 1. international electric vehicle symposium; Phoenix, Arizona, USA (5 Nov 1969). International electric vehicle symposium.
ELECTRIC-POWERED VEHICLES;USES;TECHNOLOGY ASSESSMENT;PROPULSION;ELECTRIC MOTORS;ELECTRIC BATTERIES;CONTROL EQUIPMENT;BUSES;TRUCKS; REGENERATIVE BRAKING;WEIGHT;EFFICIENCY

4878 (CONF-691143--, pp 285-315) EXPERIMENTAL ELECTRIC VEHICLES. Koch, W.H.; Eames, D.B. Nov 1969.
From 1. international electric vehicle symposium; Phoenix, Arizona, USA (5 Nov 1969). International electric vehicle symposium.
ELECTRIC-POWERED VEHICLES;RESEARCH PROGRAMS; DESIGN;MECHANICAL TRANSMISSIONS;PERFORMANCE TESTING;LEAD-ACID BATTERIES;URBAN AREAS; OPERATION;CONTROL EQUIPMENT;ELECTRONIC CIRCUITS; USES

4879 (CONF-691143--, pp 316-321) HIGH PERFORMANCE AC ELECTRIC DRIVE FOR VEHICLES. Wakefield, E.H. Nov 1969.
From 1. international electric vehicle symposium; Phoenix, Arizona, USA (5 Nov 1969). International electric vehicle symposium.
ELECTRIC-POWERED VEHICLES;ELECTRIC MOTORS; SPEED REGULATORS;THYRISTORS;TORQUE;REGENERATIVE BRAKING;EFFICIENCY;ELECTRIC BATTERIES

4880 (CONF-691143--, pp 322-327) THIRD AND FOURTH GENERATION EFP ELECTRIC VEHICLES. Aronson, R.R. Nov 1969.
From 1. international electric vehicle symposium; Phoenix, Arizona, USA (5 Nov 1969). International electric vehicle symposium.
ELECTRIC-POWERED VEHICLES;RESEARCH PROGRAMS; FUNCTIONAL MODELS;PERFORMANCE TESTING;SAFETY; CONTROL EQUIPMENT;ELECTRIC MOTORS;ELECTRIC BATTERIES

4881 (CONF-691143--, pp 329-338) BATTERY POWERED ELECTRIC BUSES. Borisoff, B. Nov 1969.
From 1. international electric vehicle symposium; Phoenix, Arizona, USA (5 Nov 1969). International electric vehicle symposium.
ELECTRIC-POWERED VEHICLES;BUSES;ELECTRIC BATTERIES;ELECTRIC MOTORS;MECHANICAL TRANSMISSIONS;OPERATION;COST;PERFORMANCE

4882 (CONF-691143--, pp 339-344) END-OF-RUN CHARGING FOR METROPOLITAN AREA ELECTRICALLY-POWERED BUSES. Shafer, W.H.; Hemminger, T.E. Nov 1969.
From 1. international electric vehicle symposium; Phoenix, Arizona, USA (5 Nov 1969).
International electric vehicle symposium.
ELECTRIC-POWERED VEHICLES;BATTERY CHARGING; BUSES;PERFORMANCE TESTING;OPERATION;ENERGY CONSUMPTION;ELECTRIC BATTERIES

4883 (CONF-691143--, pp 434-461) ELECTRIC VEHICLE DEVELOPMENT IN JAPAN. Inagaki, M. Nov 1969.
From 1. international electric vehicle symposium; Phoenix, Arizona, USA (5 Nov 1969).
International electric vehicle symposium.
ELECTRIC-POWERED VEHICLES;JAPAN;FUNCTIONAL MODELS;SPECIFICATIONS;PERFORMANCE;ELECTRIC BATTERIES;DESIGN

4884 (CONF-691143--, pp 462-506) DESIGN AND PERFORMANCE PREDICTION FOR ELECTRIC VEHICLES. Kariya, T. Nov 1969.
From 1. international electric vehicle symposium; Phoenix, Arizona, USA (5 Nov 1969).
International electric vehicle symposium.
ELECTRIC-POWERED VEHICLES;DESIGN;PERFORMANCE; ELECTRIC MOTORS;MATHEMATICAL MODELS; ACCELERATION;POWER;REGENERATIVE BRAKING;SPEED REGULATORS;FUNCTIONAL MODELS;THYRISTORS;TESTING; ELECTRIC BATTERIES

4885 (CONF-691143--, pp 507-527) ELECTRIC VEHICLE DEVELOPMENT IN THE UNITED KINGDOM. Tomblin, N.H. Nov 1969.
From 1. international electric vehicle symposium; Phoenix, Arizona, USA (5 Nov 1969).
International electric vehicle symposium.
UNITED KINGDOM;ELECTRIC-POWERED VEHICLES; COORDINATED RESEARCH PROGRAMS;AUTOMOBILES;BUSES; TRUCKS;ELECTRIC BATTERIES;BATTERY CHARGERS;COST; PERFORMANCE;SOCIO-ECONOMIC FACTORS;REVIEWS

4886 (CONF-691143--, pp 528-535) BRITISH MANUFACTURER'S WAY WITH BATTERY ELECTRIC VEHICLES. Hender, B.S. Nov 1969.
From 1. international electric vehicle symposium; Phoenix, Arizona, USA (5 Nov 1969).
International electric vehicle symposium.
ELECTRIC-POWERED VEHICLES;DESIGN;ELECTRIC BATTERIES;ELECTRIC MOTORS;CONTROL EQUIPMENT; BATTERY CHARGING

4887 (CONF-691143--, pp 540-549) LOW-LOSS MOTOR CONTROLLER COMBINATION IN AN ELECTRIC CAR. Byrne, J.V.; Lacy, J.G. (Univ. Coll., Dublin). Nov 1969.
From 1. international electric vehicle symposium; Phoenix, Arizona, USA (5 Nov 1969).
International electric vehicle symposium.
ELECTRIC-POWERED VEHICLES;SPEED REGULATORS; ELECTRONIC CIRCUITS;CONTROL SYSTEMS;BATTERY CHARGERS;TIRES;PERFORMANCE;REGENERATIVE BRAKING; ELECTRIC BATTERIES

4888 (CONF-691143--, pp 550-552) URBAN ELECTRICAL VEHICLE EMA 1. (Research and Development Laboratories for Electrical Rotating Machines, Brno). Nov 1969.
From 1. international electric vehicle symposium; Phoenix, Arizona, USA (5 Nov 1969).
International electric vehicle symposium.
ELECTRIC-POWERED VEHICLES;SPECIFICATIONS; ELECTRIC MOTORS;ELECTRIC BATTERIES;TIRES; PERFORMANCE;MECHANICAL STRUCTURES;BRAKES

4889 (CONF-710233--, pp 7p, Paper 15) STUDIES BY FIAT ON THE ELECTRICALLY-DRIVEN AUTOMOBILE. Brusaglino, G. (Fiat Research and Development, Turin). 1971.
From Conference on low pollution power systems development; Eindhoven, Netherlands (23 Feb 1971).
Technical report of the conference on low pollution power systems development.
ELECTRIC-POWERED VEHICLES;AUTOMOBILES; RESEARCH PROGRAMS;FUNCTIONAL MODELS;PERFORMANCE TESTING;SPECIFICATIONS;ELECTRIC MOTORS;ELECTRIC BATTERIES;PLANNING;LEAD-ACID BATTERIES;USES

4890 (CONF-710233--, pp 23p, Paper 11) HYBRID HEAT ENGINE/ELECTRIC SYSTEMS STUDY. Meltzer, J. (Aerospace Corp., El Segundo, CA). 1971.
From Conference on low pollution power systems development; Eindhoven, Netherlands (23 Feb 1971).
Technical report of the conference on low pollution power systems development.
HYBRID ELECTRIC-POWERED VEHICLES;AUTOMOBILES; HYBRID SYSTEMS;FEASIBILITY STUDIES;HEAT ENGINES; ELECTRIC BATTERIES;DESIGN;PERFORMANCE;EXHAUST GASES;REVIEWS;TRUCKS;BUSES;EFFICIENCY;COST

4891 (CONF-711166--, pp 473-481) REAL-TIME SIMULATION OF LOADS FOR ELECTRIC VEHICLE BATTERIES. Roe, R.B. (ESB Inc., Yardley, PA). Nov 1971.
From 2. international electric vehicle symposium; Atlantic City, New Jersey, USA (8 Nov 1971).
International electric vehicle symposium.
Controlled track testing provides a realistic method of evaluating the performance of an electric-vehicle battery system, but it is difficult, time-consuming, and expensive. Real-time load simulation is a procedure for testing batteries or other power sources under conditions which duplicate those of actual operation. It allows laboratory determination of field performance. The system and procedure for real-time simulation are described. Logic diagrams for the system and its most important part, the programmable load module, are given. Preliminary analysis of field measurements on the ESB Electric Vehicle over metropolitan cycles is discussed. Additional capabilities of the system are indicated. 6 figures. (RWR)

4892 (CONF-711166--) INTERNATIONAL ELECTRIC VEHICLE SYMPOSIUM, ATLANTIC CITY, NEW JERSEY, 8--10 NOVEMBER 1971. (Electric Vehicle Council, New York (USA)). Nov 1971. 783p. Electric Vehicle Council, New York, NY.
From 2. international electric vehicle symposium; Atlantic City, New Jersey, USA (8 Nov 1971).
Fifty-five papers, opening remarks for the various sessions, and one paper abstract are presented. The sessions are: (1) general session; (2) international session; (3) off-the-road vehicles; (4) electric vehicle components; (5) electric vehicle systems; (6) on-the-road vehicles; (7) electric railways; (8) battery research; (9) hybrid and flywheel systems; (10) on-campus activity session; and (11) a concluding session. A separate abstract was prepared for each of the fifty-five papers for the Energy Data Base. (PMA)

4893 (CONF-711166--, pp 15-42) ELECTROCHEMICAL FUTURE. Bockris, J.O. Nov 1971.
From 2. international electric vehicle symposium; Atlantic City, New Jersey, USA (8

Nov 1971).
International electric vehicle symposium.
The air pollution problem associated with fossil-fuel driven automobiles is reviewed, and the possibilities of powering electric automobiles with storage batteries and fuel cells are discussed. Problems include: (1) slow recharging; (2) thermal pollution from primary energy sources; (3) high initial cost; (4) lack of current research; and (5) low performance (acceleration, etc.). Running costs would be less; even now, the cost of driving electric cars on hydrogen, using fuel cells, would be less than that of using tax-free present gasoline. (PMA)

4894 (CONF-711166--, pp 51-55) WATTS ON. Hender, B.S. Nov 1971.
From 2. international electric vehicle symposium; Atlantic City, New Jersey, USA (8 Nov 1971).
International electric vehicle symposium.
A brief review of work in electric-powered vehicle technology being carried out in Europe is given. Topics include electric batteries, electric motors, control systems, torque converters, motor brushes, and battery chargers. (PMA)

4895 (CONF-711166--, pp 56-69) DAIHATSU ELECTRIC VEHICLES. Takaoka, I.; Yumoto, I.; Kawakatsu, S. (Daihatsu Kogyo Co., Ltd., Osaka). Nov 1971.
From 2. international electric vehicle symposium; Atlantic City, New Jersey, USA (8 Nov 1971).
International electric vehicle symposium.
Specifications and performance data are presented for an electric-powered vehicle used as a signtseeing taxicab at the EXPO '70 site. Several other electric-powered models are described, including a three-wheeled compact, a van, and a pick-up truck. (PMA)

4896 (CONF-711166--, pp 70-82) DEVELOPMENT OF THE ELECTRIC VEHICLE AT NISSAN MOTOR CO., LTD. Watnabe, A. (Nissan Motor Co., Tokyo). Nov 1971.
From 2. international electric vehicle symposium; Atlantic City, New Jersey, USA (8 Nov 1971).
International electric vehicle symposium.
The electric-powered vehicle development program of the Nisson Motor Company is described, and specifications are given for various experimental and prototype vehicles. A shorthaul urban electric vehicle was developed under the following criteria: 30 mile driving range per charge; maximum speed of about 30 mph; and that it be easily driven. (PMA)

4897 (CONF-711166--, pp 83-86) NEW CHANCES FOR ELECTRIC ROAD VEHICLES. Muller, I.H.G. Nov 1971.
From 2. international electric vehicle symposium; Atlantic City, New Jersey, USA (8 Nov 1971).
International electric vehicle symposium.
The two major problems associated with electric-powered vehicles are their high cost and the heaviness of the batteries which reduces range. Realistic possibilities are discussed for making electric road traffic economical and for solving the range problem satisfactorily. (PMA)

4898 (CONF-711166--, pp 87-96) BRITISH ELECTRIC VEHICLES IN COMMERCIAL AND MUNICIPAL USE. Warrington, J.M. Nov 1971.
From 2. international electric vehicle symposium; Atlantic City, New Jersey, USA (8 Nov 1971).
International electric vehicle symposium.
A brief description is given of some new developments in British electric-powered vehicles for commercial and municipal use. The vehicles described rely on lead--acid batteries, since the lead--acid remains the most highly developed, economical, and reliable. Topics discussed include control systems, a dairy vehicle, a metropolitan delivery van, refuse collection vehicles, street cleaning vehicles, ambulances, a multi-purpose high voltage sub-station vehicle, and personnel carriers. (PMA)

4899 (CONF-711166--, pp 102-110) CZECHOSLOVAK ELECTRIC CAR EMA 1 AND EMA 2. Seda, I.B. (Research and Development Inst. for Electrical Machines, Brno). Nov 1971.
From 2. international electric vehicle symposium; Atlantic City, New Jersey, USA (8 Nov 1971).
International electric vehicle symposium.
The design and performance testing of an electric-powered automobile and an electric-powered platform delivery truck are described. The automobile, designated EMA 1, is designed for the city transport of two adults and two children and uses standard lead--acid storage batteries. The electric truck, EM2, has a load carrying capacity of one ton and also uses lead--acid batteries. Topics discussed include electric motors, speed control, performance, weight, brakes, chassis, and transmissions. (PMA)

4900 (CONF-711166--, pp 117-120) RIDE: DON'T WALK. Balfour, R.L. Nov 1971.
From 2. international electric vehicle symposium; Atlantic City, New Jersey, USA (8 Nov 1971).
International electric vehicle symposium.
The development of an aluminum electric-powered golf car is described. A high-speed model was driven almost 5,000 miles in New York, was licensed by the state of New York, and passed the state's vehicle inspection. It achieves speeds of 24 to 26 mph and operates up to 53 miles on a single battery charge. (PMA)

4901 (CONF-711166--, pp 121-125) RIDE: DON'T WALK. Davis, R.E. Nov 1971.
From 2. international electric vehicle symposium; Atlantic City, New Jersey, USA (8 Nov 1971).
International electric vehicle symposium.
An electric-powered riding mower presently manufactured and marketed by John Deere is described. The electric motors are powered by three 12V deep-cycle batteries, which can be drained and recharged many times. Battery charging, machine operation, power transmission, safety features, and machine cost are discussed. (PMA)

4902 (CONF-711166--, pp 126-128) INDUSTRY GOES FOR ELECTRICS. Leighton, E.H. Nov 1971.
From 2. international electric vehicle symposium; Atlantic City, New Jersey, USA (8 Nov 1971).
International electric vehicle symposium.
The use of electric-powered trucks, principally fork lift trucks, in the materials handling industry, is discussed. Recent battery developments, solid-state controls, and improved high-voltage systems have made electric trucks much more economical. Savings

resulting from high-rise materials storage are also discussed. (PMA)

4903 (CONF-711166--, pp 129-135) INDUSTRY GOES FOR ELECTRICS. Carliss, O.S. Nov 1971.
From 2. international electric vehicle symposium; Atlantic City, New Jersey, USA (8 Nov 1971).
International electric vehicle symposium.
The use of electric-powered trucks in industry is compared with that of internal combustion engine trucks. The mounting concern over internal combustion exhaust gases makes electric-powered vehicles more attractive. Building ventilation is an added cost affecting capital, operation cost, and maintenance costs. Noise is also becoming a serious factor. (PMA)

4904 (CONF-711166--, pp 136-138) WE USE ELECTRICS. Kohler, R.L. Nov 1971.
From 2. international electric vehicle symposium; Atlantic City, New Jersey, USA (8 Nov 1971).
International electric vehicle symposium.
The savings realized by using electric-powered lift trucks for stores operations at the Potomac Edison Company are discussed. Total average cost of using an electric unit for one year was found to be $344 versus $1,142 per year for a gasoline-powered unit. (PMA)

4905 (CONF-711166--, pp 149-171) APPLICATION OF POWER SEMICONDUCTORS IN ELECTRIC VEHICLES. Bixby, B.J.; Borst, D.W.; Carver, L.R. (International Rectifier, El Segundo, CA). Nov 1971.
From 2. international electric vehicle symposium; Atlantic City, New Jersey, USA (8 Nov 1971).
International electric vehicle symposium.
Power semiconductor devices used in dc to dc converters are discussed with particular reference to electric-vehicle applications. A representative vehicle drive has a dc power source and a series motor controlled by a chopper regulator. Methods of achieving desired thyristor and rectifier diode characteristics are discussed. (PMA)

4906 (CONF-711166--, pp 187-227) CONTROL AND CHARGING SYSTEMS FOR ELECTRIC VEHICLES. Gurwicz, D. Nov 1971.
From 2. international electric vehicle symposium; Atlantic City, New Jersey, USA (8 Nov 1971).
International electric vehicle symposium.
Solid state electronic circuits for use in conjunction with electric vehicle dc motors are discussed. Topics include: (1) control systems using SCR's; (2) braking systems (including regenerative braking); (3) separately excited (shunt) motor control systems; (4) battery charging systems; and (5) an integrated control and charging system. (PMA)

4907 (CONF-711166--, pp 333-343) DESIGN AND DEVELOPMENT OF A VAN WITH AN A-C ELECTRIC DRIVE. Murphy, G.J. Nov 1971.
From 2. international electric vehicle symposium; Atlantic City, New Jersey, USA (8 Nov 1971).
International electric vehicle symposium.
The design and construction of a 7500 pound electric-powered van are described. The van is powered by lead-acid batteries and an ac induction motor controlled by solid state electronic circuits. The operation of the motor and associated electronics is described, and block diagrams of the various systems are given. (PMA)

4908 (CONF-711166--, pp 344-372) CASE HISTORY AND ECONOMIC STUDY OF AN ELECTRIC COMMUTER VEHICLE. Thiele, T.N.; Moore, D.L. Nov 1971.
From 2. international electric vehicle symposium; Atlantic City, New Jersey, USA (8 Nov 1971).
International electric vehicle symposium.
The design and performance testing of an electric-powered vehicle (a converted Karmann Ghia limited to two passengers) is described. Thirty lead--acid batteries provided a 120V system, yielding a one hour discharge capacity of 19.5 KWh. A standard 4-speed mechanical transmission and clutch were used, and the shunt-wound motor was static field controlled. The motor, power train, controls, operating experience, and cost considerations are discussed. (PMA)

4909 (CONF-711166--, pp 373-388) DEVELOPMENT OF A SECOND GENERATION ELECTRIC HIGHWAY VEHICLE AND SUPPORT EQUIPMENT. Goldman, W.E. Nov 1971.
From 2. international electric vehicle symposium; Atlantic City, New Jersey, USA (8 Nov 1971).
International electric vehicle symposium.
A program to design and test electric-powered automobiles is described. Several prototypes were developed, and improvements in batteries, the front wheel drive system, and vehicle construction are discussed. Results are given of tests of range and acceleration. (PMA)

4910 (CONF-711166--, pp 394-404) WE ARE READY. Hafer, P.R. Nov 1971.
From 2. international electric vehicle symposium; Atlantic City, New Jersey, USA (8 Nov 1971).
International electric vehicle symposium.
The history, use, and operating characteristics of multistop vehicles (delivery trucks, for example) are presented, and a research and development program for electric-powered multistop vehicles is described. Testing of a van and two buses has shown that such vehicles are ready to be put to practical use. Vehicle performance and components are described, and air pollution problems due to electric-powered vehicles and internal combustion engines are compared. (PMA)

4911 (CONF-711166--, pp 405-407) EFP PREPRODUCTION ELECTRIC PROTOTYPES. Aronson, R.R. Nov 1971.
From 2. international electric vehicle symposium; Atlantic City, New Jersey, USA (8 Nov 1971).
International electric vehicle symposium.
A brief description is given of a new product line of electric-powered vehicles including: a full-sized, 6-passenger sedan; a middle-sized 4-door station wagon for five passengers and 500 pounds of cargo; a two-door wagon accommodating two passengers and 500 pounds of cargo; and a 2-door four passenger shopper or commuter car. The batteries, control systems, and equipment for these cars are discussed. (PMA)

4912 (CONF-711166--, pp 408-432) FEASIBILITY STUDY OF THE ELECTRIC CAR FOR HAWAII. Hwang, H.H. Nov 1971.
From 2. international electric vehicle symposium; Atlantic City, New Jersey, USA (8 Nov 1971).

International electric vehicle symposium.
Preliminary results are presented of a system study to determine the feasibility of widespread use of the electric car in Hawaii. The study consists of the following two major parts: (1) the derivation of specifications of an electric commuter car and of an electric utility van in accordance with Oahu's driving conditions; and (2) the estimation of the number of electric cars that can be powered by Hawaiian Electric Company's present generating capacity. Results of the study are summarized, and design criteria for electric cars are discussed. The method used for estimating the number of electric cars which Hawaiian Electric Company's present generating capacity can power is described, and sample calculations for power and energy requirements for electric cars are given.

4913 (CONF-711166--, pp 699-725) PHYSICS AND THE ELECTRIC MOTORCYCLE. deBellis, T. Nov 1971.
From 2. international electric vehicle symposium; Atlantic City, New Jersey, USA (8 Nov 1971).
International electric vehicle symposium.
A description is given of an electric motorcycle built and tested by high school physics students. The physics of the vehicle design is given, including the electric battery, aerodynamics, and the electric motor. The electric cycle proved to be quiet and economical, and the acceleration was very rapid although jerky. (PMA)

4914 (CONF-711166--, pp 726-731) ELECTRIC VEHICLE ACTIVITY A GEORGIA TECH. Finley, C.C. Nov 1971.
From 2. international electric vehicle symposium; Atlantic City, New Jersey, USA (8 Nov 1971).
International electric vehicle symposium.
A report is given on the present status of a design project on electric vehicles at the Georgia Institute of Technology. Past efforts for participation in the Clean Air Car Race are discussed, as well as future plans in preparation for the Urban Vehicle Design Competition.

4915 (CONF-711166--, pp 744-749) ELECTRIC BUSES FOR LANSING, MICHIGAN. Erickson, C.R. Nov 1971.
From 2. international electric vehicle symposium; Atlantic City, New Jersey, USA (8 Nov 1971).
International electric vehicle symposium.
General specifications are currently being drawn for bids for six electric buses for use in a downtown mall-type area. State and federal funds will be used to finance the project, which will also include nine gasoline-powered buses, two radio equipped vans, and four conventional Diesel buses. A description is given of four proposals for the electric buses received from three different manufacturers of battery-powered buses and one from a manufacturer of battery-powered propulsion systems. (PMA)

4916 (CONF-711166--, pp 579-605) OVERVIEW OF HYBRID VEHICLES. Rosen, C. Nov 1971.
From 2. international electric vehicle symposium; Atlantic City, New Jersey, USA (8 Nov 1971).
International electric vehicle symposium.
Several alternative methods of meeting the 1976 Federal emission standards are proposed, and a hybrid heat engine/electric system appears to be cost and performance competitive with the suggested alternatives. The history of early automotive engines and hybrids is given, and series and parallel hybrids are compared. Exhaust gases and emission controls are discussed for a spark ignition engine/electric battery hybrid. (PMA)

4917 (CONF-711166--, pp 606-642) ASSESSMENT OF THE HYBRID HEAT ENGINE/ELECTRIC POWERTRAIN FOR USE IN URBAN BUSES. Lapedes, D.E. Nov 1971.
From 2. international electric vehicle symposium; Atlantic City, New Jersey, USA (8 Nov 1971).
International electric vehicle symposium.
A recently concluded major study to examine the hybrid heat engine/electric system as a potential low-pollution power source in street-operated vehicles is described. This system ranked high on Environmental Protection Agency's list of possible low-pollution power sources that might provide an alternative to the internal combustion engine. The specific purposes of the study were to provide EPA with a detailed analysis of the design feasibility of the hybrid system and an estimate of expected exhaust emission levels. Hence, the effort was directed primarily at providing an analysis of the system by examining through computer simulation the performance and exhaust emissions of vehicles operating over select driving cycles. In addition, general design goals were established for components and subsystems in the vehicle power-train for near-term prototype versions (circa 1975). The propulsion system investigated in the EPA study was limited solely to that hybrid heat engine/electric powertrain concept in which the power for vehicle propulsion is supplied by two specific sources: a heat engine and a set of batteries. The heat engine is designed to supply cruise power while the batteries are designed to supply power for acceleration. In this combination the heat engine can be reduced markedly in size compared to a conventional propulsion system and, by restricting the rpm range and permitting only slow acceleration of the engine, its design and operation can be optimized to substantially reduce exhaust emissions and enhance longevity. Moreover, the benefits accruing from restricted operation of the engine may also carry over to ancillary equipment such as catalytic converters.

4918 (CONF-711166--, pp 643-652) TEST RESULTS ON HYBRID VEHICLES. Friedmen, D. Nov 1971.
From 2. international electric vehicle symposium; Atlantic City, New Jersey, USA (8 Nov 1971).
International electric vehicle symposium.
Minicars, Inc. has been studying urban transportation systems since 1967. These studies included the development of special vehicles and computerized control systems to monitor the transportation systems. The last prototype vehicle developed for the Minicar Transit System in 1969 was a hybrid gasoline/electric vehicle. It was designed to meet special requirements imposed by safety, air pollution and size considerations. The development work on this hybrid power train indicated that there is a reduction in exhaust emissions when hybrid is compared with the normal ICE. More reduction is needed. The performance of the electrical system shows that the batteries used for these tests were acceptable as the energy storage element in the parallel hybrid system. The shunt DC motor/generator with armature and field control performed satisfactorily. The electric machine

continuous rated at 9.7 hp was capable of supplying the peak power of 27 hp when external cooling was applied. The new solid state controller proved to be simple, reliable, inexpensive, and sufficient for the present requirement.

4919 (CONF-711166--, pp 682-698) WHICH ARE BETTER FOR ELECTRIC VEHICLES: FLYWHEELS OR BATTERIES. Hoffman, G.A. Nov 1971.
From 2. international electric vehicle symposium; Atlantic City, New Jersey, USA (8 Nov 1971).
International electric vehicle symposium.
The result is given of an evaluation of flywheels of advanced design. The investigations promised no hope for flywheels to find eventual major use in vehicle propulsion. The best of flywheels simply compare unfavorably with batteries on most counts. Flywheel power plants turned out to be inferior in all instances in performance to batteries, from both standpoints of specific power and of specific energy. Furthermore, the environmental hazards posed even by the safest of these flywheels were assessed riskier than those of batteries, and cost-estimates for flywheels indicated that energy storage in rotokinetic devices will be twice to four times as expensive as in batteries.

4920 (CONF-711166--, pp 732-738) URBAN CAR FOR THE 1980'S. Bloom, J.A.; Root, R.M.; Alic, J.A. Nov 1971.
From 2. international electric vehicle symposium; Atlantic City, New Jersey, USA (8 Nov 1971).
International electric vehicle symposium.
The following design goals were established for an urban car: (1) should be substantially smaller than conventional cars; (2) must carry two persons; (3) must produce little or no toxic emissions at street level; (4) should protect the occupants from serious injury in a 50 mph barrier crash; (5) must be undamaged in 5 mph front and rear collisions; (6) must have a cruising speed of at least 45 mph; (7) must have a range of at least 50 miles in city driving; (8) must be able to accelerate from 0 to 45 mph in 15 seconds (0.14 g average); (9) must be able to decelerate from 45 to 0 mph in 85 feet (0.8 g average); (10) should have a noise level of 60 dB-A or below inside passenger compartment at 30 mph; (11) should have an exterior noise level below 65 dB-A at full acceleration from 30 mph; (12) should have minimum of 4 $ft^3$ of storage space; and (13) should have a consumer cost in mass production of less than $2500. These goals are examined and justified.

4921 (CONF-730848--1) ELECTRIC CAR. Nelson, P.A. (Argonne National Lab., Ill. (USA)). 1973. 10p. Dep. NTIS $3.00.
From International symposium and workshop on the hydrogen economy; Ithaca, New York, USA (19 Aug 1973).
AUTOMOBILES;DESIGN;ELECTRIC BATTERIES; HYDROGEN;AUTOMOTIVE FUELS;HYDROGEN FUELS; ECONOMICS;EFFICIENCY;ELECTRIC-POWERED VEHICLES; LITHIUM;SULFUR;COMPARATIVE EVALUATIONS

4922 (CONF-740215--1) ANL HIGH-ENERGY BATTERIES FOR ELECTRIC VEHICLES. Nelson, P.A.; Chilenskas, A.A.; Walsh, W.J.; Gay, E.C. (Argonne National Lab., Ill. (USA)). 1974. 18p. Dep. NTIS $3.00.
From 3. international electric vehicle symposium; Washington, District of Columbia, USA (19 Feb 1974).
Li/LiCl--KCl/S. ELECTRIC BATTERIES;DESIGN; PERFORMANCE;AUTOMOBILES;ELECTRIC-POWERED VEHICLES;LITHIUM;SULFUR;LITHIUM CHLORIDES; POTASSIUM CHLORIDES

4923 (CONF-740215--P1, pp 11p, Paper 7405) BATTERY MANUFACTURE'S POINT OF VIEW. David, E.E. Jr. 1974.
From 3. international electric vehicle symposium; Washington, District of Columbia, USA (19 Feb 1974).
Proceedings of the third international electric vehicle symposium.
The challenge a battery manufacturer must accept and the responsibility he must assume if electric vehicles are to compete successfully with internal combustion engine vehicles are discussed. An assessment of new, high-energy density batteries for electric vehicle applications is given, and when they will become commercially available is discussed. Batteries, electrical systems, and vehicle manufacturers' interactions with mass merchandisers and the electric utility industry to make vehicles successful commercial realities are described.

4924 (CONF-740215--P1, pp 11p, Paper 7410) ELECTRIC VEHICLE PROPULSION SYSTEMS IN TERMS OF ENERGY ECONOMY AND ECOLOGY. Mueller, H.G. (Rheinisch-Westfaelisches Elektrizitaetswerk Ag, Essen). 1974.
From 3. international electric vehicle symposium; Washington, District of Columbia, USA (19 Feb 1974).
Proceedings of the third international electric vehicle symposium.
World-wide shortages, declining availability, and rising prices are expected to characterize future world oil supplies, impairing area-orientated individual transport systems which depend exclusively on petroleum derivates. Electric energy can be generated from many different primary energy sources, among which non-polluting nuclear energy will gain increasingly in importance in future. Electric power meets all conceivable requirements of environmental protection, and is therefore particularly suitable as a traction or propulsion energy source in road transport. Electromobiles and their propulsion and control components can be composed of modules developed by related technologies and can assume many transport functions, especially in the traffic patterns of conurbations. Major development tasks exist for the storage of electric energy and for suitable supply and service infrastructure. Standards and technical specifications have to be developed rapidly, and they must be based on empirical values derived from major model experiments and tests. Such major test projects require both close cooperation between government authorities, industry and science and generous promotion by subsidies from public funds.

4925 (CONF-740215--P1, pp 15p, Paper 7411) SUPPLY OF PROPULSION ENERGY TO ELECTRICALLY POWERED VEHICLES AND ITS INCORPORATION IN THE LOAD CURVES OF PUBLIC UTILITIES. Oehms, K.J. (Rheinisch-Westfaelisches Elektrizitaetswerk AG, Essen); Busch, H. 1974.
From 3. international electric vehicle symposium; Washington, District of Columbia, USA (19 Feb 1974).
Proceedings of the third international electric vehicle symposium.
Electric power, which can be generated from many different sources of primary energy, has well proved its merits as a medium of energy easy to distribute while not polluting the

environment for many applications, and will have to be made available increasingly also for the supply of electric road vehicles during the eighties. As is the case with other types of equipment, the operating characteristics of electric road vehicles as well as the geographic and time pattern of their energy demand to be covered by supply facilities will have to be studied in order to develop patterns for a practical incorporation of the new consumers in the load potential of supply networks. By an optimum design and organization of the overall infrastructure for the supply of electric road vehicles, which can be achieved by several methods to be tested in large-scale type experiments for their relative merits, the total costs for this type of propulsion energy can be reduced to a minimum.

4926 (CONF-740215--P1, pp 41p, Paper 7418)
THEORETICAL APPROACH TO ELECTRIC BATTERY VEHICLE PERFORMANCE. Walz, A.H. (Technische Univ., Berlin). 1974.
From 3. international electric vehicle symposium; Washington, District of Columbia, USA (19 Feb 1974).
Proceedings of the third international electric vehicle symposium.
The mechanics of vehicles of any kind (including electric) are already developed as far as forces, powers, and energy required at the wheels are concerned. A brief statement of related results is given. The special feature of low battery energy density and corresponding high ratio of battery weight to total vehicle weight is considered by an additional set of equations describing the efficiency behavior of the electric components (battery, motor, and speed control). Thus, a useful theoretical basis for numerical design optimization at given requirements of performance is established.

4927 (CONF-740215--P1, pp 20p, Paper 7421)
HOW TO CONVERT PETROL-CARS INTO ELECTRIC CARS. Sandelowsky, S. 1974.
From 3. international electric vehicle symposium; Washington, District of Columbia, USA (19 Feb 1974).
Proceedings of the third international electric vehicle symposium.
Gasoline cars and vehicles used in innertown-traffic, where speed is limited and daily range is low can easily be produced as electric cars and vehicles without considerable increase of costs. Starting with a discussion of general conditions for innertown traffic, (i.e. acceleration, security, costs, maintenance, economy) details such as power, driving system, fuel consumption and general performance are discussed. Features and performance of electric motors are discussed with regard to different design, especially the current consumption for certain traffic situations. The battery problem, typical battery performance, and electric driving systems are considered, and speed control, how it is done now and how it should be made for reasons of economy and for suitable conversion solutions, is described. Examples of converted vehicles and of costs and weight are presented.

4928 (CONF-740215--P1, pp 21p, Paper 7426)
INDUSTRIAL TRUCKS: A STATUS REPORT ON ELECTRICS IN EUROPE. Gribble, D.C. (Lead Development Association, London). 1974.
From 3. international electric vehicle symposium; Washington, District of Columbia, USA (19 Feb 1974).
Proceedings of the third international electric vehicle symposium.
Battery-powered trucks have come under intense selling competition from diesels all over Europe. One reason is that diesel oil has been cheaper as a fuel than battery power, but this is likely to be reversed in favor of electrics when the new oil prices take effect. Developments in self-compensating chargers and easier-to-service truck controllers are designed to make electrics even simpler to operate while improving flexibility. The user of trucks, who has the last say, has fully endorsed the innovations of recent years and is still very battery minded. The outlook, therefore, remains good for electrics and battery power.

4929 (CONF-740215--P1, pp 14p, Paper 7427)
CARE AND MAINTENANCE OF ELECTRIC VEHICLES. Schultz, G.V. 1974.
From 3. international electric vehicle symposium; Washington, District of Columbia, USA (19 Feb 1974).
Proceedings of the third international electric vehicle symposium.
A discussion is given of maintenance costs and procedures for electric lift trucks or individual vehicles, and these are compared to gasoline-powered vehicles. Electronic test facilities, battery charging and battery acid loss are considered, and tables of ownership and maintenance costs and a recommended schedule of maintenance are included. (PMA)

4930 (CONF-740215--P1, pp 6p, Paper 7428)
DEVELOPMENT OF ELECTROCHEMICAL POWER SOURCES FOR ELECTRIC VEHICLES. George, J.H.B. 1974.
From 3. international electric vehicle symposium; Washington, District of Columbia, USA (19 Feb 1974).
Proceedings of the third international electric vehicle symposium.
An overview of the rather complicated and somewhat frustrating field of research into electrochemical power sources for electric vehicles is presented. The long-term outlook for battery-powered electric vehicles has, of course, been improved considerably by the recent events: because they use a universal fuel, electricity, derived from a great variety of primary energy sources, which in their diversity provide some assurance of continuity in supply; and because the performance and economic advantages of conventionally-powered vehicles, hitherto overwhelmingly superior to electrics in all except special situations, are now being eroded by a number of factors, some related to the increased cost of energy, and others to environmental clean-up, which have every appearance of being permanent. It seems unlikely, however, that self-propelled electric vehicles will ever achieve more than secondary importance in our total transportation system without the development of greatly improved power sources. Approaches to improving electrochemical power sources and their present state of development are reviewed.

4931 (CONF-740215--P1, pp 13p, Paper 7439)
U.S. POSTAL SERVICE: RESEARCH AND ENGINEERING DEPARTMENT ELECTRIC VEHICLE DEVELOPMENT AND TESTING PROGRAM. Makrides, G. 1974.
From 3. international electric vehicle symposium; Washington, District of Columbia, USA (19 Feb 1974).
Proceedings of the third international electric vehicle symposium.
The current U.S. Postal Service Electric Vehicle Program was initiated: (1) to demonstrate that battery-powered electric vehicles can be used to perform various delivery missions; (2) to support the national

program on ecology; and (3) to provide more effective fuel allocation. Postal routes for home and business delivery of mail and parcels are made to order for electric vehicles. Analysis of postal delivery route profiles shows that they consist of; (1) short ranges (the national average is 14 miles for 60,000 quarter-ton vehicles); (2) moderate speeds and accelerations; (3) high rate of stops per mile with considerable idle time (routes may have as many as 30 stops per mile, including scheduled and unscheduled stops); and (4) closed cycles (where vehicles leave and return to specified parking areas nightly and remain parked for periods of time from 15 to 18 hours). All these route conditions suit the electric vehicles' capabilities and do not stress greatly their limitations. The U.S. Postal Service, Research and Engineering Department, has supported under contract the design and fabrication of three different designs of quarter-ton capacity electric vehicles. Prototype models were built in early 1973, and test results for these prototypes are described.

4932 (CONF-740215--P1, pp 12p, Paper 7445) COMPARISON BETWEEN A PICK-UP VAN WITH INTERNAL COMBUSTION ENGINE AND AN ELECTRIC PICK-UP VAN. Altendorf, J.P.; Kalberlah, A.; Saridakis, N. (Volkswagenwerk AG, Wolfsburg, Germany). 1974.

From 3. international electric vehicle symposium; Washington, District of Columbia, USA (19 Feb 1974).

Proceedings of the third international electric vehicle symposium.

During the last few years an electric vehicle based on the VW Transporter has been developed and built in the Volkswagenwerk. About 20 of these vehicles and the push-through battery changing system are to be tested in collaboration with the Rheinisch Westfalische Elektrizitatswerke AG (RWE). The platform truck was chosen from the VW Transporter range as it appeared to be most suitable for this purpose on account of the existing storage compartment which allows the battery to be pushed in and out from both sides. A comparison is given of this electric vehicle with the platform truck driven by an internal combustion engine. To start with, the relationships between gross vehicle weight, battery weight, payload and range are discussed in general for this purpose. A comparison is then made between the two Transporters in respect of construction, driving characteristics and road performance. Furthermore, the possible applications for the electric vehicle in particular are discussed and the annual costs determined using certain assumptions.

4933 (CONF-740215--P1, pp 6p, Paper 7446) INTEGRATING PRODUCTION ELECTRIC VEHICLES INTO USER FLEETS. Warrington, J.M. (Harbilt Construction Co., Market Harborough, England). 1974.

From 3. international electric vehicle symposium; Washington, District of Columbia, USA (19 Feb 1974).

Proceedings of the third international electric vehicle symposium.

A discussion is given of the market potential for electric-powered vehicles in user fleets. Fleet owners who have fify vehicles or more centered in congested areas will have at least 15% of jobs achievable by electric vehicles. Although the vehicles are initially more expensive, about one-third of the cost is due to batteries, and the cost of battery recharging is practically negligible. Ease of maintenance is also a good selling point for electric vehicles. (PMA)

4934 (CONF-740215--P1, pp 22p, Paper 7450 A) EXPERIENCE WITH ELECTRIC DRIVES FOR VEHICLES. Domann, H.; Renner, S. 1974.

From 3. international electric vehicle symposium; Washington, District of Columbia, USA (19 Feb 1974).

Proceedings of the third international electric vehicle symposium.

The selection of the shunt-wound direct-current machine should be based on the requirements which a vehicle drive must fulfill. A thyristor control unit and auxiliary units are described, and results of test drives with a standard city bus are discussed.

4935 (CONF-740215--P2, pp 35p, Paper 7414) ELECTRIC VEHICLE SYSTEMS STUDY. Unnewehr, L.E. (Ford Motor Co., Dearborn, MI). 1974.

From 3. international electric vehicle symposium; Washington, District of Columbia, USA (19 Feb 1974).

Proceedings of the third international electric vehicle symposium.

The results of an extensive evaluation of electric vehicles is presented. Electric vehicle power trains are discussed, and it is noted that the technology required to build electric drives for vehicles is highly developed and capable of mass produced vehicles at the present time. Three types of potentially viable electric vehicles are discussed. The small city car and the van could find considerable application in today's transportation scheme, but still suffer a cost penalty over conventional ICE vehicles. The third car, a higher-performing metropolitan car, must await the development of high-energy batteries to become feasible.

4936 (CONF-740215--P2, pp 29p, Paper 7420) EFP'S CURRENT PROGRAM. Aronson, R.P. (Electric Fuel Propulsion Corp., Detroit). 1974.

From 3. international electric vehicle symposium; Washington, District of Columbia, USA (19 Feb 1974).

Proceedings of the third international electric vehicle symposium.

In June of this year, EFP (Electric Fuel Propulsion Corporation) will begin limited production of a highway passenger car similar to the Electrosport car whose performance is described in the Dana Corporation Test Report E-1870 attached to this paper. Top speed-69 mph; range-50 to 100 miles on a charge; acceleration-0 to 30 mph in less than 10 seconds. The charge time of the special tri-polar, lead-cobalt batteries in this car is approximately 37 minutes for an 80 percent recharge. Later on, a smaller car will be produced with an improved range performance similar to that shown in the Cornell/General Motors Test Report attached to this paper (CAL Report No. VJ-2623-K-1). These cars are made from specially designed chassis--built from the ground up--upon which regular Detroit production bodies are placed. The cars are not converted vehicles in the ordinary sense. They are designed to meet all applicable Federal Safety Standards. The new cars will be equipped with a second generation tri-polar, lead-cobalt battery never used before in an EFP car. This battery is described in U.S. Patent 3,518,127 attached to this paper. According to laboratory tests, this new battery will deliver approximately 20 percent more energy density at high discharge rates than the first generation tri-polar batteries which were used in the 60 vehicles EFP has produced in the past 7 years, including those vehicles covered by the Dana and Cornell/General Motors Test Reports.

4937 (CONF-740215--P2, pp 17p, Paper 7416)
ELECTRIC VEHICLES: POINT OF VIEW OF AN AUTOMOBILE MANUFACTURER. Gastaut, G. 1974.
From 3. international electric vehicle symposium; Washington, District of Columbia, USA (19 Feb 1974).
Proceedings of the third international electric vehicle symposium.
The RENAULT Group did not wish until now to discuss problems linked with possible electric vehicles, since the progress accomplished was small and the performance characteristics of such vehicles were far removed from those of conventional vehicles. Therefore, it was not believed that a beginning of a market could exist for such vehicles. Nevertheless, the Design departments of RENAULT and SAVIEM are working, directly or with outside companies, on batteries, electric motors, electronic regulation and, more generally, on the various possibilities of drive trains using electric power, at least in part. Different reasons have modified this attitude and make us now consider as possible the existence in the near future of a beginning of a market for such vehicles. These reasons are of two sorts: technical and economic. They were the ones which resulted in the signature of an important agreement between TREGIE (Group of Economic Interest including RENAULT, SAVIEM and SERI) and ELECTRICITE DE FRANCE (E.D.F.) (French Electric Power Authority). A report is given which tries to review these reasons and to show how an automobile manufacturer draws industrial consequences from them.

4938 (CONF-740215--P2, pp 30p, Paper 7478)
ELECTRICAL PROPULSION SYSTEMS FOR ROAD VEHICLES STATE OF THE ART AND PRESENT-DAY PROBLEMS. Bader, I.; Plust, H.G. (Deutsche Automobilgesellschaft mbH, Esslingen, Germany). 1974.
From 3. international electric vehicle symposium; Washington, District of Columbia, USA (19 Feb 1974).
Proceedings of the third international electric vehicle symposium.
An analysis of various all-electric and electro-hybrid drive versions has revealed that at the moment the only possible source of energy for electro-powered vehicle is the lead-acid battery, but that in the future also alkaline and high-temperature accumulators might gain increasing importance since using these units might mean a reduction in operating cost of the vehicles thus equipped. As a result, optimization of electrical propulsion systems for road vehicles at the moment means to minimize the weight of the energy storage unit that is necessary to meet the specified transport requirements and to make the fullest possible use of the limited amount of energy available. Future developments in the field of electrical drive units should aim at cutting down the considerable cost of operation in the starting range due to the power electronic system in accordance with the comparatively short periods of operation within this range.

4939 (CONF-740215--P2, pp 45p, Paper 7480)
EXPERIMENTS ON A TRIAL SERIES OF ELECTRICAL VEHICLES. Cochat, M.; Heurtin, J.; Wolf, R. 1974.
From 3. international electric vehicle symposium; Washington, District of Columbia, USA (19 Feb 1974).
Proceedings of the third international electric vehicle symposium.
A trial series of 90 light utility vehicles have been made by E.D.F. (Electricite de France) to be tested under ordinary working conditions. Those using them are either E.D.F. employees, municipal workers, or are employed in public or private enterprises. A description is given of the vehicles and their dynamic performance during the experiments, and a comparison is made with theoretical calculations. The experiments and work carried out on the vehicles are described, and the road-worthiness, maintenance, and energy consumption are considered with respect to the type of use.

4940 (CONF-740215--P2, pp 13p, Paper 7451)
SIMULATION OF LEAD--ACID CELLS. Moerdijk, M.C.W.; Venderbosch, H.W.; Kema, N.V. 1974.
From 3. international electric vehicle symposium; Washington, District of Columbia, USA (19 Feb 1974).
Proceedings of the third international electric vehicle symposium.
The possibility was investigated of providing trolley-buses with a small trailer supplied with a lead battery meant to be charged by the overhead wires. This enables the buses to run independently of overhead wires for some distance, which results in a greater flexibility in service. Simulation of the behavior of lead accumulators is especially useful in case of erratic charging patterns as occur in electric traffic. Complicated switching operations during battery testing to achieve certain types of currents are then superfluous (inadmissible simplifications of charging patterns during tests can be avoided). Another advantage is that more knowledge is obtained about the behavior and the limitations of the battery. A tentative description is given of the time dependent processes in a lead accumulator. Further refinements are possible, such as, e.g., the inclusion of a separator.

4941 (CONF-740215--P2, pp 24p, Paper 7430)
ZINC--AIR BATTERIES IN VEHICULAR APPLICATIONS. Appleby, A.J.; Pompon, J.P.; Jacquier, M. (Center de Recherches de la Compagnie Generale d'Electricite, Marcoussis, France). 1974.
From 3. international electric vehicle symposium; Washington, District of Columbia, USA (19 Feb 1974).
Proceedings of the third international electric vehicle symposium.
A zinc-air battery system is described in which the electrolyte is maintained in circulation and carries with it the active anode material (zinc powder). A discussion is given of why this system was chosen for an electric vehicle battery and under what conditions it represents an optimum solution. The circulating Zn-air system appears to be technically and economically well-placed when compared with other electric vehicle power sources. Its advantages may be summarized as follows: (1) its high performance is suited to a wide range of urban vehicle types; (2) utilization logistics are similar to present gasoline-powered vehicles; (3) its present high level of technological development is such that short-term introduction may be envisaged; and (4) price calculations show costs that are competitive with other electric (and gasoline) vehicle power systems.

4942 (CONF-740215--P2, pp 16p, Paper 7459)
FEASIBILITY STUDY OF ELECTRIC BUSES FOR PUBLIC TRANSIT IN HONOLULU, HAWAII. Hwang, H.H.; Okawa, R.T. (Univ. of Hawaii, Honolulu). 1974.
From 3. international electric vehicle symposium; Washington, District of Columbia, USA (19 Feb 1974).
Proceedings of the third international

electric vehicle symposium.
A self-propelled electric bus with a curb weight of 20,000 pounds and a seating capacity of 49 passengers appear to be technically feasible for use in Honolulu. The 4,375 pound lead-acid traction batteries currently available are capable of meeting the power requirements of such a bus, permitting it to perform comparably to the conventional bus. Limitations in driving range do exist. However, if air conditioning is not used, the bus is capable of making round trips on the shorter routes with one fully charged battery. If battery-charging stations are built such that the bus can obtain on-route battery replacements, then the bus is capable of making round trips on all routes. The majority of the routes require one battery change for a round trip when air conditioning is used. It is estimated that the electric bus needs less than one-half of the fuel required to power a conventional bus. Therefore, the implementation of electric buses is very timely and urgent at this moment of critical fuel shortage.

4943 (CONF-740215--P2, pp 15p, Paper 7460)
M.A.N.: ELECTRO BUS PLANNING AND FIRST TESTS. Hagen, H. (Maschinenfabrik Augsburg-Nurnberg (M.A.N.), Munich). 1974.
From 3. international electric vehicle symposium; Washington, District of Columbia, USA (19 Feb 1974).
Proceedings of the third international electric vehicle symposium.
In conjunction with Bosch, Varta and RWE, M.A.N. (Maschinenfabrik Augsburg-Nurnberg) developed a battery-powered electro-bus, in which the power supply unit is in an attached single-axle trailer. In this way it is possible to make the battery large enough for corresponding driver power without limiting the useful load possibilities of the vehicle. On the basis of the plan described, two prototypes were built and tried out in practical city service. The test results and furthar development are reported.

4944 (CONF-740215--P2, pp 24p, Paper 7462)
URBAN PUBLIC TRANSPORT IN FRANCE BY AUTONOMOUS ELECTRIC-POWERED BUS: REPORT AND ACTUAL TESTING OVER A TWO-YEAR PERIOD AND A DISTANCE OF 15,000 MILES. Lefort, L.; Martin, G.M. 1974.
From 3. international electric vehicle symposium; Washington, District of Columbia, USA (19 Feb 1974).
Proceedings of the third international electric vehicle symposium.
A discussion is given of the design and performance testing of a twenty-two passenger electric bus powered by lead-acid batteries. Various technical problems brought out by tests are described, and the economic results (cost per kilometer) are discussed. Two minibusses, in a year and a half, ran a cumulative distance of over 25,000 kilometers (15,540 miles) without any major trouble. (PMA)

4945 (CONF-740215--P2, pp 27p, Paper 7466)
WHO NEEDS ELECTRONICS. TORQUE CONVERTERS CAN DO THE JOB. Mangan, M.F.; Griffith, J.T. (Electricity Council Research Centre, Capenhurst, England). 1974.
From 3. international electric vehicle symposium; Washington, District of Columbia, USA (19 Feb 1974).
Proceedings of the third international electric vehicle symposium.
The problems associated with the development of the high powered electric road vehicle have been tackled mainly by the use of electronic controllers and compatible motors. As a technical solution to the problems, this approach has been very successful, but it has resulted in an expensive technology which is not in the usual repertoire of the automotive industry. An alternative approach using mechanical controlling elements is described which uses established automotive technology and which can be designed to give similar overall performance at a potentially lower price. Tests on an experimental van using the motor and industrial converter described have shown the reliable mixed driving range to be in excess of 40 miles, with a maximum recorded range in commuter driving of 53 miles per charge with an acceleration after 25 miles of between 14 and 15 seconds for 0 to 30 mph. These results were obtained using a battery pack which gave 230 Ah maximum from a nominal 96V lead acid battery. These figures are not as impressive as those claimed for vehicles fitted with electronic controllers but they were achieved using standard components with a minimum of capital and development cost. Similar development devoted to improvements in torque converter couplings would substantially improve the overall efficiency and since automotive technology is directly involved, such an approach could prove more attractive to the automotive industry.

4946 (CONF-740215--P2, pp 15p, Paper 7469)
BATTERY CHARGE CONDITION MONITORING: TECHNIQUES AND APPLICATIONS. Christianson, C.C. (Gould Labs., St. Paul). 1974.
From 3. international electric vehicle symposium; Washington, District of Columbia, USA (19 Feb 1974).
Proceedings of the third international electric vehicle symposium.
A description and comparison of the techniques available for monitoring battery charge condition are given. Attention will be primarily given to those techniques which are useful with lead-acid and nickel-cadmium batteries since these two types are primarily in use today. Some of the techniques will be applicable to any type of battery. A number of alternatives exist for accomplishing battery charge condition monitoring. The lead-acid battery is well suited to approaches based upon measurements of battery parameters where one of the most useful techniques is that incorporating an IR compensated terminal voltage. Coulometric techniques are suitable for essentially any type of battery. The most useful approaches are probably those which provide a signal proportional to the battery's charge condition. Coulometric techniques, for example, are essentially the only ones compatible with nickel-cadmium type batteries. Since coulometric techniques determine the battery recharge condition indirectly through measurement of battery charge and discharge currents, special application problems are involved in terms of maintaining synchronization between the actual battery's charge condition and that indicated by the coulometer. An accurate battery charge condition signal can be most useful in electric vehicle applications and can provide new ways for innovative system designers to solve their system application problems.

4947 (CONF-740215--P2, pp 25p, Paper 7470)
IMPACT OF ELECTRIC CARS FOR THE LOS ANGELES INTRASTATE AIR QUALITY CONTROL REGION. Hagey, G.; Hamilton, W.F. 1974.
From 3. international electric vehicle symposium; Washington, District of Columbia, USA (19 Feb 1974).
Proceedings of the third international

electric vehicle symposium.
Under the Clean Air Act Amendments of 1970, the Environmental Protection Agency promulgated National Ambient Air Quality Standards on April 30, 1971. The Los Angeles Air Quality Control Region, as well as certain other regions, will not be able to attain and maintain these ambient air qualities by combinations of emission controls on stationary sources and vehicles unless transportation controls are also used. It is conceivable that the future air quality in these areas might benefit from the use of electric cars. For example: a two-car strategy wherein non-electric cars are restricted from the heart of the urban area; or a strategy wherein electric cars account for a portion of the vehicle miles travelled throughout the area. Early results are presented from an ongoing EPA-sponsored study conducted by the General Research Corporation on the impact of electric cars for the Los Angeles Air Quality Control Region. The study is examining present and projected future electric car technology, and impacts in the areas of the environment, energy, natural resources, the transportation system and the economy. The study time periods are: present to 1985, and 1985 to 2000.

4948 (CONF-740215--P2, pp 14p, Paper 7473) DEVELOPMENT OF ELECTRIC VEHICLES IN JAPAN. Smith, G.E. (Univ. of Michigan, Ann Arbor). 1974.
From 3. international electric vehicle symposium; Washington, District of Columbia, USA (19 Feb 1974).
Proceedings of the third international electric vehicle symposium.
The development of electric vehicles in Japan is being actively pursued by several industrial and governmental concerns with the five year program funded by the federal government providing a large impetus to this development. It is significant that the agency through whom the funds are being appropriated has the responsibility for developing technologies to further the economic strength and development in Japan. Thus it would seem that the Japanese government expects the electric vehicle to have a market as a viable means of transportation. Those interested in electric vehicles will anxiously await the conclusions and results drawn from this program in Japan.

4949 (CONF-740215--P2, pp 25p, Paper 7461) OUTLINE PROJECT OF A HYBRID BUS. Brusaglino, G. (Technological Research Center, Turin); Bertoldi, F. 1974.
From 3. international electric vehicle symposium; Washington, District of Columbia, USA (19 Feb 1974).
Proceedings of the third international electric vehicle symposium.
A study was made of a hybrid bus for urban public transportation which would have low emissions and high performance levels. Diesel engines, gas turbines, Rankine engines, and stirling engines are evaluated as prime movers, while the energy storage systems considered were storage batteries and flywheels. The chosen system is a gas turbine-storage battery hybrid with separately excited dc motors. A description is given of the systems, components, and operating modes, and the basic design criteria of the vehicle and the propulsion system are described. Consideration is given to automatic programmed acceleration control. (PMA)

4950 (CONF-740341--P1, pp vp, Paper 7) BATTERIES FOR PEAKING GENERATION. Berkowitz, D.G.; Brown, J.T. 1974.
From Electric utility engineering conference; Pittsburgh, Pennsylvania, USA (3 Mar 1974).
1974 electric utility engineering conference. Volume I.
OFF-PEAK ENERGY STORAGE;ELECTRIC BATTERIES; POWER GENERATION;PERFORMANCE;POWER DEMAND; ECONOMICS;OPERATION

4951 (CONF-751238--, pp 58-61) UNITED KINGDOM'S RESEARCH AND DEVELOPMENT PROGRAM STATUS. Donald, G. (Dept. of the Environment, London). 1975.
From Symposium on low pollution power systems development; Rome, Italy (3 Dec 1975).
Symposium on low pollution power systems development.
A summary is given of the status of key research and development programs related to Low Pollution Power Systems Development (LPPSD) which the United Kingdom is pursuing. Topics include: (1) diesel engine noise; (2) sodium-sulfur batteries; (3) pollution control equipment; (4) stratified charge engines; (5) diesel exhaust odors; and (6) fuel economy.

4952 (CONF-760112--1) BATTERY RESEARCH SPONSORED BY THE U.S. ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION. Landgrebe, A.A.; Nelson, P.A. (Argonne National Lab., Ill. (USA)). 1976. Contract W-31-109-eng-38. 12p. Dep. NTIS $3.50.
From Symposium on United States lithium resources and requirements by the year 2000; Lakewood, Colorado, USA (22 Jan 1976).
An important part of the Energy Storage Program of the U.S. Energy Research and Development Administration is the development of storage batteries for load-leveling on electric utilities and automotive propulsion, and for application to new energy generating systems. The successful development of batteries for these purposes will provide significant savings of oil resources and will also have beneficial environmental effects. A very high manufacturing volume may be required for these batteries and the availability of the required raw materials is an important consideration. Lithium--aluminum/iron sulfide batteries show promise both for utility energy-storage batteries and electric vehicle batteries, and serious consideration should be given by the lithium industry to the availability of lithium resources. (auth)

4953 (CONF-760469--3) BATTERIES FOR UTILITY LOAD LEVELING. Nelson, P.A., Yao, N.P. (Argonne National Lab., Ill. (USA)). 1976. W-31-109-ENG-38 . 22p. Dep. NTIS $3.50.
From American power conference; Chicago, Illinois, USA (20 Apr 1976).
A critical need for conservation is to reduce the use of dwindling oil and gas resources in electric energy generation. Leveling or peak shaving electric utility loads by means of off-peak energy storage devices would allow an orderly shift to increased utilization of base-load energy, and thereby decrease the use of oil and gas by turbine generators. The concept of energy storage by batteries is particularly attractive for electric utility applications. This paper addresses three key areas: the technical and economic requirements of batteries for applications to electric utilities, the near-term technology for the lead--acid battery and the prospect for its use in utility applications, and the development status and the incentives for developing advanced battery

technology. The Battery Energy Storage Test Facility is also briefly discussed; it will provide a test bed for advanced batteries in a utility network. 1 figure, 6 tables. (RWR)

4954 (CONF-770430--P4(Draft), pp vp,) FIAT ELECTRIC CITY CAR PROTOTYPE. Brusaglino, G. (Centro Ricerche FIAT, Turin). 1977.
From 4. international symposium on automotive propulsion systems; Washington, District of Columbia, USA (17 Apr 1977).
Fourth international symposium on automotive propulsion systems. Volume IV.
Electric vehicles represent an important research activity at FIAT. One of the themes was the development of a two-seater city car prototype with properly designed body. The main purpose was to define a vehicle capable of meeting the requirements of comfortable and easy driving, handling, and parking and suitable performance for urban operation on level or hilly routes. The general concept is in accordance to near-future solution of the electrical power equipment, both for propulsion and on-board storage system. The propulsion system consists in a separately excited high specific power dc motor fed by transistor double chopper; a Ni-Zn battery has been recently provided for on-board storage equipment. A technical description is given, and results of road tests are reported.

4955 (CONF-770430--P4(Draft), pp vp,) PERIPHERIC EQUIPMENT FOR REDUCING MAINTENANCE OF ELECTRIC VEHICLE LEAD--ACID BATTERIES. Salamon, K. (VARTA Batterie AG, Kelkheim, Germany). 1977.
From 4. international symposium on automotive propulsion systems; Washington, District of Columbia, USA (17 Apr 1977).
Fourth international symposium on automotive propulsion systems. Volume IV.
Maintenance as well as controlling of electric-vehicle-batteries becomes a more and more important problem when the number of vehicles is increasing. Therefore, not only the energy-density of a battery but also the comfort of handling and servicing wins growing interest. This is the reason for considerable efforts in developing special devices called ''periphere components'' for easier maintenance and supervision of the battery and its performance. Some new developments on this field are reported: (1) gas recombination by catalysts; (2) central topping-up systems for eacy refilling of the battery; (3) monitoring of acid density, charge indicator; and (4) battery-cooling for heavy duty batteries.

4956 (CONF-770430--P4(Draft), pp vp,) PERFORMANCE STANDARDS FOR ELECTRIC VEHICLES. Brennand, J. (General Research Corp., Santa Barbara, CA). 1977.
From 4. international symposium on automotive propulsion systems; Washington, District of Columbia, USA (17 Apr 1977).
Fourth international symposium on automotive propulsion systems. Volume IV.
The rationale leading to recommendations for specific performance standards for near-term and advanced electric vehicles which are to be leased or purchased by the U.S. Energy Research and Development Administration is set forth. The underlying analytical basis is derived. Performance standards include ranges from 50 km (J227a/C, near-term private vehicles) to 150 km (J227a/D, advanced private vehicles). Energy consumption maximums at the input to the charger are 0.25 and 0.2 kW.h/ km for the private vehicles (near-term and advanced), and 0.45 and 0.35 kW.h/km for commercial vehicles.

4957 (CONF-770430--P4(Draft), pp vp,) SYSTEMATIC APPROACH TO THE EVOLUTION OF HIGH PERFORMANCE ELECTRIC VEHICLES. O'Connell, L.G. (Univ. of California, Livermore); Cooper, J.F.; Miller, A.B.; Newkirk, H.W. 1977.
From 4. international symposium on automotive propulsion systems; Washington, District of Columbia, USA (17 Apr 1977).
Fourth international symposium on automotive propulsion systems. Volume IV.
The performance characteristics of current and future electric vehicles are examined and compared to projected heat engine vehicle parameters. The shortcomings of electric vehicles in the near-term time frame are discussed. It is predicted that the all-electric vehicle will not gain wide acceptance in the near future because of degraded performance characteristics. Because the near-term low acceptance level of electric vehicles is caused by their overall lower performance level, a hybrid concept is examined which may give an enhanced performance level in the short range future. This type of vehicle is proposed as a much needed transition system to provide an evolutionary change from the heat engine system vehicle of today to electric vehicles with acceptable performance in the future.

4958 (CONF-770430--P4(Draft), pp vp,) FOUR PASSENGER ELECTRIC VEHICLE DESIGN. Schwarz, R. (ASL Engineering, Inc., Goleta, CA). 1977.
From 4. international symposium on automotive propulsion systems; Washington, District of Columbia, USA (17 Apr 1977).
Fourth international symposium on automotive propulsion systems. Volume IV.
A discussion is given of the tradeoffs involved in the design of a general purpose four-passenger electric vehicle. The advantages and disadvantages of three design approaches--series motor with chopper controller, separately excited motor with field control, and flywheel/electric hybrid--are discussed, along with the impact of battery characteristics on the performance of these three systems. The approaches taken in various aspects of vehicle design, including packaging, aerodynamics, and safety, to optimize overall performance and utility, are also discussed.

4959 (CONF-770430--P4(Draft), pp vp,) DESIGN OF A CURRENT TECHNOLOGY ELECTRIC VEHICLE. Guess, R.; Nial, W.; Pocobello, M. 1977.
From 4. international symposium on automotive propulsion systems; Washington, District of Columbia, USA (17 Apr 1977).
Fourth international symposium on automotive propulsion systems. Volume IV.
The U.S. Energy Research and Development Administration (ERDA) has initiated a program to develop totally new electric vehicles by 1979 with substantially improved performance over those available today. The rationale used in designing a 4 passenger electric vehicle for use in an urban environment is presented. A description is given of that part of the ERDA program undertaken by the General Electric Company with Triad Services, Incorporated as a subcontractor. The approach taken was to design an electric vehicle utilizing current technology and on the basis of trade-off analysis results identify the upgrading utilizing more advanced technology to reach ERDA goals. Advanced technology was to be incorporated to the extent it could be developed and made available by July, 1978. The

Current Technology Vehicle design represented the best that could be done with technology commercially available in 1976. The vehicle design, the drive train, the major components, and the control are described. The Current Technology Vehicle specifications as well as the general dimensional and weight characteristics are given. ERDA performance goals for a Near Term electric car are compared to the GE-1977 Current Technology Vehicle performance goals.

4960 (CONF-770430--P4(Draft), pp vp,) ELECTRIC- AND HYBRID-VEHICLE POWERTRAIN DEVELOPMENT. Altendorf, J.P.; Kalberlah, A.; Saridakis, N. (Volkswagenwerk AG, Wolfsburg, Germany). 1977.
From 4. international symposium on automotive propulsion systems; Washington, District of Columbia, USA (17 Apr 1977).
Fourth international symposium on automotive propulsion systems. Volume IV.
The advantages and disadvantages of electric and hybrid-drive vehicles are enumerated, and some possible uses of these types of vehicles are discussed. A detailed description is given of the VW electric delivery truck system consisting of the vehicle itself and the peripheral equipment required to operate it. Hybrid drive systems are also discussed. Both structure and function of a drive system of this kind are described in some detail as implemented by VW in a minibus. Emission and fuel consumption data derived from experiments performed on this vehicle are given.

4961 (CONF-770430--P4(Draft), pp vp,) FLYWHEEL ELECTRIC MOTOR HYBRID POWER TRAIN FOR ELECTRIC VEHICLES. Kugler, G.C. (ESB Tech. Center, Yardley, PA). 1977.
From 4. international symposium on automotive propulsion systems; Washington, District of Columbia, USA (17 Apr 1977).
Fourth international symposium on automotive propulsion systems. Volume IV.
A hybrid drive train for electric vehicles is described. The unit includes a flywheel to limit the power demands on the battery and an electric motor as the main power source. Advantages include extended battery life, increased range, and improved acceleration. The flywheel is of conventional design and the entire unit uses presently available components and materials. The advantages of the drive train increases as the number and severity of accelerations and decelerations in the driving cycle increase.

4962 (CONF-770430--P4(Draft), pp vp,) FLYWHEEL-BATTERY HYBRID POWER SYSTEM: A CONCEPT TO IMPROVE ELECTRIC VEHICLE PERFORMANCE. Davis, D.D.; Epps, R.C. (Univ. of California, Livermore). 1977.
From 4. international symposium on automotive propulsion systems; Washington, District of Columbia, USA (17 Apr 1977).
Fourth international symposium on automotive propulsion systems. Volume IV.
A concept for powering the automobile is re-examined: a hybrid propulsion system design based upon demonstrated technology that could substantially improve performance, range, and consumer acceptability of a battery-powered electric vehicle. In the proposed power system, a high-energy composite flywheel is coupled to a simple, efficient, electro-mechanical transmission. Today's ''state-of-the art'' lead-acid as well as near-term and advanced battery types are examined as prime power sources. Interactive control of battery and/or flywheel drive power is provided by a versatile microprocessor-based power control unit. In the power system proposed, the flywheel augments the battery during periods of high power demand: starting, acceleration, and hill climbing. The battery supplies cruise-and-control power plus the energy required to replenish flywheel losses. With battery power demand stabilized at a low value, specific energy is maintained near maximum resulting in increased vehicle range. Vehicle kinetic energy is restored to the flywheel when traveling downhill or during any period of deceleration. The flywheel-battery hybrid is thus able to make efficient use of a regenerative braking system to recover energy. A one and a half times greater range, when compared to all-battery power, is predicted for the hybrid-powered vehicle when operated in a stop-and-go commuter environment. Acceleration rates approaching those of internal combustion powered vehicles are attainable with the hybrid power system.

4963 (CONF-770430--P4(Draft), pp vp,) BATTERY-FLYWHEEL POWER SYSTEM FOR AN URBAN AUTOMOBILE. Rowlett, B.H. (AiResearch Manufacturing Co., Torrance, CA). 1977.
From 4. international symposium on automotive propulsion systems; Washington, District of Columbia, USA (17 Apr 1977).
Fourth international symposium on automotive propulsion systems. Volume IV.
A description is given of the work being done under contract to the Energy Research and Development Administration for an advanced electric vehicle design that includes a new concept that integrates the advantages of a flywheel energy storage system into a battery-powered automobile to reduce the fundamental performance limitations of the battery-powered vehicle. An output-coupled split-differential transmission is used to link the flywheel to the output shaft. The flywheel supplies the energy for all of the high-power requirements, which results in good vehicle acceleration characteristics; the combination of regenerative braking and load leveling of the battery current results in improved range of the vehicle.

4964 (CONF-770430--P4(Draft), pp vp,) NEW LOOK AT FLYWHEEL PROPULSION FOR URBAN TRANSIT BUSES. Lawson, L.J. (AiResearch Manufacturing Co., Torrance, CA). 1977.
From 4. international symposium on automotive propulsion systems; Washington, District of Columbia, USA (17 Apr 1977).
Fourth international symposium on automotive propulsion systems. Volume IV.
A program was initiated recently by the U.S. Department of Transportation Urban Mass Transportation Administration which is directed toward the demonstration and ultimate production of energy efficient transit buses that eliminate the noise, air pollution, and odors characteristic of present diesel buses. The results of the first tasks of the study phase of the program have shown the viability of four flywheel-propulsion configurations that can match or exceed the performance and route requirements of typical transit properties. These new flywheel drives are: (1) a pure flywheel system capable of operating several miles between short enroute or stationary charges; (2) a flywheel/battery hybrid system that uses a small flywheel to provide load leveling for the battery (which is to be periodically exchanged for recharging) and for regenerative braking; (3) a flywheel/diesel engine hybrid system in which the small flywheel reduces the required engine size by 70 percent without sacrifice of performance and provides regenerative braking; and (4) a

flywheel-augmented trolley coach that uses a relatively small flywheel to provide regenerative braking and efficient control while onwire as well as a limited offwire route capability. Due to component commonality and modularity, these concepts appear suitable to provide improved propulsion for a wide range of vehicles.

4965 (CONF-770430--P4(Draft), pp vp,) THEORETICAL PERFORMANCE UPGRADING OF THE E.V.A. ELECTRIC VEHICLE: BY USE OF A FLYWHEEL/BATTERY HYBRID POWER TRAIN SYSTEM. Davis, D.D. (Univ. of California, Livermore); Epps, R.C.; Renner, R.A. 1977.
From 4. international symposium on automotive propulsion systems; Washington, District of Columbia, USA (17 Apr 1977).
Fourth international symposium on automotive propulsion systems. Volume IV.
The performance improvement that could be realized by an electric vehicle through replacement of the existing electric drive train with one incorporating a flywheel/battery energy source is examined. The vehicle selected for the theoretical power train conversion is the electric sedan marketed by Electric Vehicle Associates (E.V.A.). The hybrid power train proposed, uses a high-energy composite flywheel coupled to a simple, efficient, electro-mechanical transmission. The lead-acid batteries installed by E.V.A. provide the prime power source. Interactive control of battery and/or flywheel drive power is provided by a versatile microprocessor-based power control unit. The flywheel allows efficient recovery of vehicle kinetic energy during braking and provides the energy base required to meet all high power transient demands. The flywheel also stabilizes battery demand at a low average value resulting in improved battery performance through increases in both cycle life and available energy. Due to the hybrid system described here, electric vehicle acceleration and range improvements are predicted to be in excess of 80 percent for the E.V.A. vehicle when operated in a stop-and-go commuter environment.

4966 (CONF-770430--P5(Draft), pp vp,) ENERGY FOR ROAD TRANSPORT IN THE UNITED KINGDOM. Porter, J.; Fitchie, J.W. (Transport and Road Research Lab., Crowthorne, Eng.). 1977.
From 4. international symposium on automotive propulsion systems; Washington, District of Columbia, USA (17 Apr 1977).
Fourth international symposium on automotive propulsion systems. Volume V.
Looking at the short-to-medium term, examples are given to illustrate the use of computer simulation and instrumented cars to identify and evaluate potential energy conservation measures. For the longer term, when natural crude oil becomes scarce and expensive, the study compares vehicles using synthetic gasoline from coal and battery vehicles and examines the factors needed to give a primary energy advantage of one type of vehicle over the other. However, other considerations need to be assessed and it is suggested that the main need now is to continue the research and initial development needed to keep both options open.

4967 (EPA--460/3-74-020-a) IMPACT OF FUTURE USE OF ELECTRIC CARS IN THE LOS ANGELES REGION. VOLUME I. EXECUTIVE SUMMARY AND TECHNICAL REPORT. Hamilton, W.F. (General Research Corp., Santa Barbara, Calif. (USA)). Oct 1974. Contract 68-01-2103. 113p. (PB--238877). Dep. NTIS $5.25.
ELECTRIC-POWERED VEHICLES;FEASIBILITY STUDIES;ENVIRONMENTAL EFFECTS;URBAN POPULATIONS; AIR POLLUTION;COST BENEFIT ANALYSIS;ECONOMICS; FORECASTING;FUEL CONSUMPTION;ELECTRIC BATTERIES; LEAD-ACID BATTERIES;NICKEL-ZINC BATTERIES;ZINC-CHLORINE BATTERIES;LITHIUM-SULFUR BATTERIES; BATTERY CHARGING;PETROLEUM;RESOURCE CONSERVATION;POWER REACTORS;USES

4968 (EPA--460/3-74-025) NICKEL--ZINC BATTERIES FOR HYBRID VEHICLE OPERATION. Sulkes, M.J. (Army Electronics Technology and Devices Lab., Fort Monmouth, N.J. (USA)). Dec 1972. 49p. NTIS.
NICKEL-CADMIUM BATTERIES;COMPARATIVE EVALUATIONS;FAILURES;HYBRID ELECTRIC-POWERED VEHICLES;ELECTRIC POTENTIAL;PERFORMANCE;WEIGHT; COST;POWER

4969 (ERDA--76-136, pp 212-218) OVERVIEW OF ERDA BATTERY PROGRAM. Landgrebe, A.R. 1976.
From Highway vehicle systems contractors coordination meeting; Ann Arbor, Michigan, USA (4 May 1976).
Highway vehicle systems contractors coordination meeting. Tenth summary report.
The battery program is very large and complex with many different programs in progress and pending. The general thrust is for co-funded programs and complete involvement with industry. In addition, close coordination and cooperation is carried on with other research organizations like EPRI and other government agencies and laboratories. The National Battery Test Facility is at Argonne National Laboratory. In addition to test and evaluation, much of the technology assessment, cost analysis, and screening of new concepts and components are carried out at this laboratory. Secondary batteries for electric vehicles offer several potential advantages including conservation of resources and favorable environmental features. Several advanced batteries under development show promise of meeting the requirements for electric vehicles within the next decade. Potential vehicle batteries include improved lead-acid, and nickel-iron for the near term (one-to-three years); advanced lead-acid and nickel-zinc for the intermediate term (three-to-five years); and metal-air, lithium-metal sulfide, sodium-sulfur and other advanced systems for the longer term (greater than five years).

4970 (ERDA--76-136, pp 221-222) NEAR TERM BATTERY DEVELOPMENT PROJECTS. Yao, N.P. 1976.
From Highway vehicle systems contractors coordination meeting; Ann Arbor, Michigan, USA (4 May 1976).
Highway vehicle systems contractors coordination meeting. Tenth summary report.
The objectives of the aqueous battery programs at Argonne National Laboratory (ANL) are: (1) research, development and demonstration of near-to intermediate-range electric vehicle batteries; (2) development of near-range lead-acid battery for demonstration in electric utility; and (3) establishment of a centralized national battery test facility. The schedule for electric vehicle battery development is given. (PMA)

4971 (ERDA/NASA/1011--77/3) NEW BATTERIES AND THEIR IMPACT ON ELECTRIC VEHICLES. Schwartz, H.J. (National Aeronautics and Space Administration, Cleveland, Ohio (USA). Lewis Research Center). 1977. Contract EX-

76-A-31-1011. 16p. (NASA-TM-X--73672). Dep. NTIS, PC A02/MF A01.

The builder of an on-the-road electric vehicle (EV) has no problem in selecting a battery today because he has little choice. For small vehicles he must use a lead-acid golf car battery, while for a larger vehicle he may choose the heavier but more durable industrial-type lead-acid battery. This situation is changing rapidly. The technical literature is filled with recent papers recounting advances in one battery type or another. Each new battery offers a different combination of energy density (which defines the range capability of the vehicle), power density (which relates to the acceleration capability), cycle life, and cost (the battery economic parameters). To an EV manufacturer, this flood of data raises two questions: (1) how do I evaluate the various candidates for my job and (2) when can I expect a new battery to be ready for my vehicle. This paper suggests answers to these questions. 6 figures, 3 tables.

4972 (LA-UR--75-1360) ELECTROCHEMICAL HEAT ENGINES FOR DIRECT ELECTRIC POWER GENERATION AND ENERGY STORAGE. Elliott, G.R.B.; Trela, W.J.; Dials, G.E. (Los Alamos Scientific Lab., N.Mex. (USA)). 1975. Contract W-7405-eng-36. 8p. (CONF-750920--1). Dep. NTIS $4.00.

From 11. propulsion conference of AIAA/SAE; Anaheim, California, USA (29 Sep 1975).

ELECTRIC BATTERIES;THERMODYNAMIC CYCLES; THERMAL POWER PLANTS;EFFICIENCY;POWER GENERATION;USES

4973 (LBL--6301) INVESTIGATION OF THE FEASIBILITY OF A DUAL MODE ELECTRIC TRANSPORTATION SYSTEM. Bolger, J.G.; Kirsten, F.A. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). May 1977. Contract W-7405-ENG-48. 159p. Dep. NTIS, PC A07/MF A01.

A study is reported which explores the feasibility of a highway transportation system that electromagnetically transfers energy to vehicles from powered roadways for high-speed or long-range travel, and uses energy stored in the vehicles for other travel. The energy coupling between roadway and vehicle is functionally similar to a transformer. The roadway energy source is imbedded flush with the roadway surface. When vehicle's energy pickups are suspended over the source, energy is magnetically coupled through the clearance gap between source and pickup. Analyses and modeling indicated that adequate power can be efficiently coupled by the system. The economics of the system appear to be favorable, and no implementational problems were identified that would make the system impractical. In addition to the engineering development of the power system, including performance verification with prototype hardware, continuing efforts should further address the effects of stray magnetic fields, the compatibility of the system with existing automobiles, electrical safety, and the process of transition from the use of existing automobiles.

4974 (N--64-19826) AMU-ANL CONFERENCE ON DIRECT ENERGY CONVERSION, NOV 4-5, 1963. (Argonne National Lab., Ill. (USA)). Dec 1963. Contract W-31-109-eng-39. 186p. (ANL--6802). NTIS.

From AMU-ANL Conference on Direct Energy Conversion; Argonne, IL (4-5 Nov 1963).

ELECTRIC BATTERIES;FUEL CELLS;SOLAR ENERGY CONVERSION;THERMIONIC CONVERTERS;THERMOELECTRIC GENERATORS;MEETINGS

4975 (N--64-28373) AUXILIARY POWER GENERATING SYSTEM FOR A LARGE SPACE LABORATORY. Secord, T.C.; Tonelli, A.D. (Douglas Aircraft Co., Inc., Santa Monica, Calif. (USA)). 4 Sep 1964. 11p. AIAA $1.00.

From 3. Biennial Aerospace Power Systems Conference; Philadelphia, PA (1-4 Sep 1964).

Solar cells, batteries, and SNAP-8 systems. SPACECRAFT POWER SUPPLIES;SOLAR CELLS;ELECTRIC BATTERIES;SNAP 8 REACTOR

4976 (N--64-32767, pp 65-89) ELECTRIC POWER GENERATION. Morris, J.F.; Nichols, L.D.; Potter, A.E., Jr.; Sanders, N.D.; Schwartz, H.J.; Stewart, W.L. 1964.

Conference on new technology.

Batteries, solar cells, thermoelectric and MHD generators, fuel cells, and thermionic converters for space vehicles. ELECTRIC BATTERIES;SOLAR CELLS;THERMOELECTRIC GENERATORS; MHD GENERATORS;FUEL CELLS;THERMIONIC CONVERTERS; SPACECRAFT POWER SUPPLIES;ENERGY CONVERSION

4977 (N--66-26772) PRELIMINARY DESIGN OF THE POWER SYSTEM FOR THE UK 3 SATELLITE. TECHNICAL MEMORANDUM, MAY 1964-FEB 1965. Cook, R.C.; Squires, M. (Royal Aircraft Establishment, Farnborough (UK)). Jan 1966. 13p. (RAE-TM-SPACE--75). NTIS.

Battery and solar cell array. SOLAR CELL ARRAYS;ELECTRIC BATTERIES;DESIGN;SATELLITES; SPACECRAFT POWER SUPPLIES

4978 (N--68-18466) SATELLITE POWER-CONDITIONING AND CONTROL: SUMMARY OF DESIGN POSSIBILITIES. Preukschat, A.W. (European Space Research and Technology Centre, Noordwijk (Netherlands)). Oct 1967. 21p. (ESRO-TM--54(ESTEC)). NTIS $3.00.

SOLAR CELL ARRAYS;ELECTRIC BATTERIES; SATELLITES;SPACECRAFT POWER SUPPLIES; PERFORMANCE

4979 (N--68-19128) ELECTRIC POWER GENERATION IN SPACE. (National Aeronautics and Space Administration, Washington, D.C. (USA)). Dec 1967. 20p. (NASA-Facts-NF--38). GPO $0.20.

SPACECRAFT POWER SUPPLIES;SOLAR ENERGY CONVERSION;SOLAR CELLS;FUEL CELLS;ELECTRIC BATTERIES;THERMIONIC CONVERTERS;BRAYTON CYCLE POWER SYSTEMS;RANKINE CYCLE;RANKINE CYCLE POWER SYSTEMS

4980 (N--68-28714) PERFORMANCE FORECAST OF SELECTED STATIC ENERGY CONVERSION DEVICES. Sherman, G.W.; Devol, L. (eds.). (Air Force Aero-Propulsion Lab., Wright-Patterson AFB, Ohio (USA)). 1967. 1168p. NTIS $3.00.

From 29. Meeting of AGARD Propulsion and Energetics Panel; Liege (12-16 Jun 1967).

SPACECRAFT POWER SUPPLIES;ELECTRIC BATTERIES; FUEL CELLS;SOLAR CELLS;PERFORMANCE

4981 (N--69-32305) NIMBUS-D SOLAR-CONVERSION POWER SUPPLY SUBSYSTEM. QUARTERLY TECHNICAL REPORT, 15 DEC 1968-15 MAR 1969. (Radio Corp. of America, Princeton, N.J. Astro-Electronics Div.). 18 Jun 1969. Contract NAS5-10470. 190p. (NASA-CR--103418; AED-R--3443; QTR--5). NTIS.

SOLAR ENERGY CONVERSION;SPACECRAFT POWER SUPPLIES;SOLAR CELL ARRAYS;ELECTRIC BATTERIES; NICKEL;CADMIUM;ELECTRIC CURRENTS;ELECTRIC POTENTIAL;RESEARCH PROGRAMS

4982 (N--69-34689) DEVELOPMENT OF BATTERIES FOR AUTOMOBILES WITH ELECTRIC PROPULSION. Dietz, H. (Bosch (R.) G.m.b.H., Stuttgart (Germany, F.R.)). Nov 1968. 8p. NTIS.
AUTOMOBILES;ELECTRIC-POWERED VEHICLES; ELECTRIC BATTERIES;FUEL CELLS;REVIEWS;USES

4983 (N--70-16227) ELECTROCHEMICAL SPACE POWER SOURCES. Cohn, E.M. (National Aeronautics and Space Administration, Washington, D.C. (USA)). Nov 1969. 443p. NTIS.
SPACECRAFT POWER SUPPLIES;FUEL CELLS;ENERGY STORAGE;ELECTROCHEMICAL CELLS;THERMODYNAMICS; ELECTROCHEMISTRY;ELECTRIC BATTERIES

4984 (N--70-24832, pp 51-4) SPACE EXPERIMENT POWER SUPPLIES. Kraemer, F.W. Oct 1969.
Univ. Coll., London., preliminary design of a cosmic x-ray survey experiment.
SPACECRAFT POWER SUPPLIES;DESIGN;SOLAR CELLS; ELECTRIC BATTERIES

4985 (N--70-25235, pp 62-98) SPACECRAFT POWER. 31 Dec 1969.
Space Programs Sum. 37-60, Vol. 3.
Solar cells, electric batteries, nuclear power, and radioisotope sources. SOLAR CELL ARRAYS;ELECTRIC BATTERIES;RADIOISOTOPE GENERATORS;SPACECRAFT POWER SUPPLIES

4986 (N--71-10585) AMERICA IN SPACE, THE FIRST DECADE: SPACECRAFT POWER. Corliss, W.R. (National Aeronautics and Space Administration, Washington, D.C. (USA)). 1969. 22p. (NASA-EP--59). NTIS.
SPACECRAFT POWER SUPPLIES;SOLAR CELLS;FUEL CELLS;ENERGY SOURCES;ELECTRIC BATTERIES;WEIGHT

4987 (N--71-19649, pp 475-523) PRIME POWER SYSTEMS. PART 6. Feb 1971.
Parametric analysis of microwave and laser systems for communication and tracking. Volume 3.
SPACECRAFT POWER SUPPLIES;SOLAR ENERGY CONVERSION;THERMOELECTRIC GENERATORS;ELECTRIC BATTERIES;FUEL CELLS;ELECTRICAL PROPERTIES; ENVIRONMENT;SOLAR CELLS;COMMUNICATIONS

4988 (N--72-19066) SOLAR CHARGER KIT: EXPERIMENTAL. Seapker, H.B.; Mount, J.W. (Army Electronics Command, Fort Monmouth, N.J. (USA)). Nov 1971. 28p. (AD--734809; ECOM--3452). NTIS.
SOLAR CELL ARRAYS;ELECTRIC BATTERIES; SPACECRAFT POWER SUPPLIES;SPECIFICATIONS

4989 (N--72-31043, pp 11-19) POWER SYSTEM OF THE AEROS SATELLITE. Mueller, W. Jul 1972.
From Spacecraft Power Conditioning Electronics Seminar; Noordwijk, Netherlands (Apr 1972).
Spacecraft power conditioning electronics. Proceedings of a seminar held at ESTEC, Noordwijk, Netherlands, Apr 1972.
SATELLITES;SPACECRAFT POWER SUPPLIES; PERFORMANCE;SOLAR CELL ARRAYS;ELECTRIC BATTERIES

4990 (NASA-SP--131) SPACE POWER SYSTEMS - ADVANCED TECHNOLOGY CONFERENCE. 1966. 285p.
SPACECRAFT POWER SUPPLIES;SOLAR CELLS; REVIEWS;BRAYTON CYCLE POWER SYSTEMS;RANKINE CYCLE POWER SYSTEMS;THERMOELECTRIC GENERATORS; FUEL CELLS;ELECTRIC BATTERIES

4991 (NP--20344) PROSPECTS FOR ELECTRIC VEHICLES. A STUDY OF LOW-POLLUTION-POTENTIAL VEHICLES--ELECTRIC. (Little (Arthur D.), Inc., Cambridge, Mass. (USA)). Oct 1969. Contract PH 86-67-108. 102p. NTIS.
ELECTRIC-POWERED VEHICLES;SPECIFICATIONS; POWER;POWER TRANSMISSION;CONTROL;COOLING; ELECTRIC BATTERIES;FUEL CELLS;HYBRID SYSTEMS; HYBRID ELECTRIC-POWERED VEHICLES;COST;POWER TRANSMISSION;PUBLIC HEALTH;BUSES;FUNCTIONAL MODELS;AUTOMOBILES;ELECTRIC MOTORS;FEASIBILITY STUDIES

4992 (NP--20357) ANALYSIS AND ADVANCED DESIGN STUDY OF AN ELECTROMECHANICAL TRANSMISSION. (TRW Systems Group, Redondo Beach, Calif. (USA)). Apr 1971. 248p. NTIS.
MECHANICAL TRANSMISSIONS;DYNAMOMETERS;DESIGN; MATHEMATICAL MODELS;INTERNAL COMBUSTION ENGINES; HYBRID SYSTEMS;EXHAUST GASES;HYBRID ELECTRIC-POWERED VEHICLES;PERFORMANCE TESTING;MOCKUP; EFFICIENCY;ELECTRIC BATTERIES;ELECTRIC-POWERED VEHICLES

4993 (NTIS/PS--75/490) ELECTRIC AUTOMOBILES (A BIBLIOGRAPHY WITH ABSTRACTS). REPORT FOR 1964--JUN 1975. Hundemann, A.S. (National Technical Information Service, Springfield, Va. (USA)). Jun 1975. 85p. NTIS $25.00.
Partial revision of COM--74-11573..
Abstracts pertaining to battery systems, costs, and evaluations of electric vehicles are presented. Included are studies on nickel-zinc and lead-acid batteries and various types of lithium cells. (Contains 80 abstracts).

4994 (NTIS/PS--76/0560) ELECTRIC AUTOMOBILES (CITATIONS FROM THE NTIS DATA BASE). REPORT FOR 1964--JUN 1976. Hundemann, A.S. (National Technical Information Service, Springfield, Va. (USA)). Jul 1976. 104p. NTIS (US Sales Only).
Supersedes NTIS/PS--75/490, and COM-74--11573. See also NTIS/PS--76/0561.
Abstracts of Federally- funded research pertaining to battery systems, costs, and evaluations of electric vehicles are presented. Included are studies on nickel--zinc and lead--acid batteries, various types of lithium cells, and hybrid heat engine/electric systems. (This updated bibliography contains 99 abstracts, 19 of which are new entries to the previous edition).

4995 (NTIS/PS--76/0561) ELECTRIC AUTOMOBILES (CITATIONS FROM THE ENGINEERING INDEX DATA BASE). REPORT FOR 1970--JUN 1976. Hundemann, A.S. (National Technical Information Service, Springfield, Va. (USA)). Jul 1976. 289p. NTIS (US Sales Only).
See also NTIS/PS--76/0560.
Citations from worldwide research cover the design of electric automobiles, vans, buses, and hybrid vehicles. Included are studies on lead--acid, zinc--air, lithium-sulfur, and nickel--cadmium batteries; fuel cells; drive trains; and chassis construction. (Contains 284 abstracts).

4996 (PB--174982) DEVELOPMENT OF ELECTRICALLY POWERED VEHICLES. (Federal Power Commission, Washington, D.C. (USA). Bureau of Power). Feb 1967. 53p. NTIS $6.00.

ELECTRIC-POWERED VEHICLES;ELECTRIC BATTERIES; LEAD-ACID BATTERIES;NICKEL-CADMIUM BATTERIES; SILVER-ZINC BATTERIES;PERFORMANCE;REVIEWS

4997 (PB--185181) EXPERIMENTAL EVALUATION OF THE MARS II ELECTRIC AUTOMOBILE. Greene, J.E. (Cornell Aeronautical Lab., Inc., Buffalo, N.Y. (USA)). Feb 1969. 151p. NTIS $6.00.
ELECTRIC-POWERED VEHICLES;PERFORMANCE TESTING;RANGE;MAINTENANCE;AUTOMOBILES;LEAD-ACID BATTERIES

4998 (PB--185182) SUMMARY REPORT ON THE EXPERIMENTAL EVALUATION OF THE MARS II ELECTRIC AUTOMOBILE. Greene, J.E. (Cornell Aeronautical Lab., Inc., Buffalo, N.Y. (USA)). Feb 1969. 35p. NTIS $6.00.
ELECTRIC-POWERED VEHICLES;BRAKES; ACCELERATION;LIFETIME;PERFORMANCE TESTING; RELIABILITY;AUTOMOBILES;ELECTRIC BATTERIES

4999 (PB--185183) EXPERIMENTAL EVALUATION OF THE MARS II ELECTRIC AUTOMOBILE SUPPLEMENTARY BARRIER COLLISION TEST. Reiman, T.W. (Cornell Aeronautical Lab., Inc., Buffalo, N.Y. (USA)). Jun 1969. 24p. NTIS $6.00.
ELECTRIC-POWERED VEHICLES;SAFETY;IMPACT TESTS;AUTOMOBILES;ELECTRIC BATTERIES

5000 (PB--193254) PROSPECTS FOR ELECTRIC VEHICLES. A STUDY OF LOW-POLLUTION POTENTIAL VEHICLES: ELECTRIC. George, J.H.B.; Stratton, L.J.; Acton, R.G. (Little (Arthur D.), Inc., Cambridge, Mass. (USA)). 15 May 1968. Contract PH-86-67-108. 104p. (ADL-C--69260). NTIS $3.00.
Batteries, fuel cells, and engine--generator--battery hybrids. ELECTRIC-POWERED VEHICLES; HYBRID ELECTRIC-POWERED VEHICLES;COMPARATIVE EVALUATIONS;ELECTRIC BATTERIES;FUEL CELLS; DESIGN;COST;REVIEWS;ELECTRIC GENERATORS;ENGINES; METAL-GAS BATTERIES;USES

5001 (PB--194814) PROSPECTS FOR ELECTRIC VEHICLES: A STUDY OF LOW-POLLUTION-POTENTIAL VEHICLES--ELECTRIC. (Little (Arthur D.), Inc., Cambridge, Mass. (USA)). Oct 1969. 105p. NTIS $3.00.
ELECTRIC-POWERED VEHICLES;HYBRID ELECTRIC-POWERED VEHICLES;FUEL CELLS;METAL-GAS BATTERIES; FORECASTING;ELECTRIC MOTORS;LEAD-ACID BATTERIES; BUSES;USES

5002 (PB--201645) HYBRID HEAT ENGINE/ ELECTRIC SYSTEMS STUDY. VOLUME 1. SECTIONS 1 THROUGH 13. FINAL REPORT, JUNE 1970--JUNE 1971. Meltzer, J.; Lapedes, D. (Aerospace Corp., El Segundo, Calif. (USA)). 1 Jun 1971. Contract FO4701-70-C-0059. 551p. (TOR--0059(6769-01)-2(Vol.1)). NTIS $6.00.
HYBRID ELECTRIC-POWERED VEHICLES;FEASIBILITY STUDIES;HEAT ENGINES;EXHAUST GASES;ELECTRIC BATTERIES;COMPARATIVE EVALUATIONS;MATERIALS; COST;STIRLING ENGINES;DIESEL ENGINES;RANKINE CYCLE ENGINES;GAS TURBINES;SPARK IGNITION ENGINES

5003 (PB--213257) DEVELOP HIGH CHARGE AND DISCHARGE RATE LEAD/ACID BATTERY TECHNOLOGY. FINAL REPORT, 28 APRIL 1971--18 MARCH 1972. Silverman, H.P. (TRW Systems Group, Redondo Beach, Calif. (USA)). Apr 1972. Contract EPA-68-04-0028. 170p. NTIS 3.00.
HYBRID ELECTRIC-POWERED VEHICLES;LEAD-ACID BATTERIES;DESIGN;BATTERY CHARGING;OPTIMIZATION; HEAT ENGINES;PERFORMANCE TESTING;MATERIALS; SUBSTRATES;PLATES

5004 (PB--216622) ELECTROCHEMICAL POWER SOURCES FOR ELECTRIC HIGHWAY VEHICLES. FINAL REPORT. George, J.H.B. (Little (Arthur D.), Inc., Cambridge, Mass. (USA)). Jun 1972. Contract DOT-TSC-4044. 29p. (ADL-C--74692). NTIS $3.00.
ELECTRIC-POWERED VEHICLES;ELECTRIC BATTERIES; FUEL CELLS;REVIEWS;LEAD-ACID BATTERIES;METAL-GAS BATTERIES;HYBRID SYSTEMS;IRON-NICKEL BATTERIES;HYDROCARBON FUEL CELLS

5005 (PB--216622) ELECTROCHEMICAL POWER SOURCES FOR ELECTRIC HIGHWAY VEHICLES. George, J.R.B. (Little (Arthur D.), Inc., Cambridge, Mass. (USA)). Jun 1972. Contract DOT-TSC-4044. 29p. (ADL-C--74692). NTIS $3.00.
ELECTRIC-POWERED VEHICLES;ELECTRIC BATTERIES; FUEL CELLS;METAL-GAS BATTERIES;LEAD-ACID BATTERIES;HYDROCARBON FUEL CELLS;REVIEWS;USES

5006 (PB--238877) IMPACT OF FUTURE USE OF ELECTRIC CARS IN THE LOS ANGELES REGION. VOLUME I. EXECUTIVE SUMMARY AND TECHNICAL REPORT. FINAL REPORT. Hamilton, W.F. (General Research Corp., Santa Barbara, Calif. (USA)). Oct 1974. Contract EPA-68-01-2103. 117p. NTIS $5.25.
AUTOMOBILES;ELECTRIC-POWERED VEHICLES;LEAD-ACID BATTERIES;REVIEWS;ELECTRIC BATTERIES; CALIFORNIA;FORECASTING;PLANNING

5007 (PB--238878) IMPACT OF FUTURE USE OF ELECTRIC CARS IN THE LOS ANGELES REGION. VOLUME II. TASK REPORTS ON ELECTRIC CAR CHARACTERIZATION AND BASELINE PROJECTIONS. FINAL REPORT. Hamilton, W.F.; Eisenhut, J.C.; Houser, G.M.; Sjovold, A.R. (General Research Corp., Santa Barbara, Calif. (USA)). Oct 1974. Contract EPA-68-01-2103. 331p. NTIS $9.50.
AUTOMOBILES;ELECTRIC-POWERED VEHICLES; CALIFORNIA;PERFORMANCE;FORECASTING;PLANNING

5008 (PB--251490, pp 10-42) POTENTIAL FOR ENERGY STORAGE SYSTEMS ON U.S. ELECTRIC UTILITY SYSTEMS. Sulzberger, V.T. (Public Service and Gas Co., Newark, NJ). Mar 1976.
Near-term energy storage technologies: workshop on lead--acid batteries, Palo Alto, California, November 18--19, 1975.
Preliminary results of an assessment of energy storage systems suitable for use by U.S. electric utility systems as peaking and intermediate generating capacity are discussed. These results, focusing on an economic comparison of selected energy storage systems, should help to identify utility requirements, potential applications, and guidelines for future R and D activities concerning energy storage systems. 3 figures, 10 tables (RWR)

5009 (PB--251490, pp 160-172) REPORT ON AN ENGINEERING STUDY OF A 20-MW, 200-MWH LEAD--ACID BATTERY ENERGY STORAGE DEMONSTRATION PLANT. Stolte, W.J. (Bechtel Corp., San Francisco). Mar 1976.
Near-term energy storage technologies: workshop on lead--acid batteries, Palo Alto, California, November 18--19, 1975.
This design study concludes that a 20-MW, 200-MWh lead--acid battery energy storage demonstration plant can be designed and constructed utilizing currently available technology. The demonstration plant would cost

$27,500,000 (July 1975 dollars) and would require 62 months to design and construct, including a two-year period for design, testing, and modification of test cells. The mature 20-MW, 200-MWh lead--acid battery energy storage plant would cost $22,000,000 in July 1975 dollars if built at the rate of ten plants per year. Implementing immediate cost reduction considerations could reduce the cost of the mature plant to $17,400,000. Only minimal environmental impacts result from constructing and operating this plant. 1 figure, 3 tables (RWR)

5010 (PB--251490, pp 174-187) TECHNICAL ANALYSIS. Birk, J.R. (Electric Power Research Inst., Palo Alto, CA). Mar 1976.
Near-term energy storage technologies: workshop on lead--acid batteries, Palo Alto, California, November 18--19, 1975.
This analysis attempts to explain the differences in alternative approaches discussed by various battery manufacturers; discuss confidence in and thoughts about the performance requirements, and cost projections of these lead--acid batteries; and project the cost ranges for battery systems. A summary of the various battery specifications and costs is given. Battery cooling/warming will be an important consideration. 1 figure, 5 tables (RWR)

5011 (PB--251490, pp 188-193) ECONOMIC ANALYSIS. Smith, J.C. Mar 1976.
Near-term energy storage technologies: workshop on lead--acid batteries, Palo Alto, California, November 18--19, 1975.
An attempt to put the information received from various manufacturers of lead--acid batteries into a utility perspective is made. ''Best guess'' numbers are used for costs of converters, cooling, and site/building/ engineering. 1 figure.

5012 (PB--251490, pp 194-209) POWER CONVERSION EQUIPMENT FOR STORAGE BATTERIES. Beck, J.W. (Electric Power Research Inst., Palo Alto, CA). Mar 1976.
Near-term energy storage technologies: workshop on lead--acid batteries, Palo Alto, California, November 18--19, 1975.
Because the energy stored in secondary batteries is retrieved as dc, equipment must be provided to convert the dc voltage and current to the 60 Hz ac energy supply required by electric utilities in the United States. The equipment performing this function is referred to often as power conditioning and control equipment, inverters, or power conversion equipment. The power conversion equipment must provide the interface between the utilities' electrical systems and the source or storage device. The requirements of the conversion equipment are discussed. The alternative approaches available to meet the requirements of the converters are introduced, and some of their salient features are mentioned. The basis for rating the power conversion equipment is discussed in the context of the equipment costs. The capabilities of the conversion equipment are treated in the context of potentially additional operating features of the batteries. 4 tables (RWR)

5013 (PB--262512) LONG TERM ENERGY ALTERNATIVES FOR AUTOMOTIVE PROPULSION: SYNTHETIC FUEL VERSUS BATTERY/ELECTRIC SYSTEM. EXECUTIVE SUMMARY. Hughes, E.E.; Walton, B.L.; Newgard, P.M.; Ryan, J.W.; Steele, R.V. (Stanford Research Inst., Menlo Park, Calif. (USA)). Aug 1976. Contract NSF-C915. 17p. (SRI-EGU--4064). NTIS, PC A02/MF A01.
See also PB--262513.
This is the executive summary report; for full report, see PB--262513.

5014 (PB--263592) STANDBY POWER FOR RAILROAD-HIGHWAY GRADE CROSSING WARNING SYSTEMS. FINAL REPORT JUN 1975--JUN 1976. Holmstrom, F.R. (Lowell Univ., Mass. (USA). Research Foundation). Sep 1976. Contract DOT-TSC-589. 26p. NTIS, PC A03/MF A01.
The requirements for standby power at railroad-highway grade crossings, as established by the states, the Association of American Railroads, and the individual railroads, are described. Standard means of satisfying these requirements, using 115 vac primary power and storage batteries for standby, are compared with a number of new techniques, now passing from experimental to operational use, that incorporate solar cells or thermoelectric generators. In addition, other even more innovative techniques are examined. The conclusion of this survey is that for most railroad grade crossing applications, the existing standard techniques (reliance on ac primary power and standby storage batteries) will continue to be the preferred choice. In a number of circumstances in which the provision of ac primary power is very expensive, the combination of solar cells or thermoelectric generators as the primary source, with storage batteries as standby, will be optimal.

5015 (TEC--75-006a) IMPACT OF FUTURE USE OF ELECTRIC CARS IN THE ST. LOUIS AND PHILADELPHIA REGIONS. VOLUME I. EXECUTIVE SUMMARY AND TECHNICAL REPORT. FINAL REPORT. Hamilton, W.F. (General Research Corp., Santa Barbara, Calif. (USA)). Sep 1975. Contract E(04-3)-1119. 109p. Dep. NTIS $5.45.
Impacts of the use of electric cars were projected for the St. Louis and Philadelphia regions in the years 1980, 1990, and 2000. As in a companion study for the Los Angeles region, the electric cars were four-passenger subcompacts using lead-acid and advanced batteries; urban driving ranges of about 55 and 140 miles, respectively, were possible. Los Angeles data indicate such cars could replace some 15 to 75 percent of future urban autos with little sacrifice of urban driving. Adequate raw materials and nighttime recharge power should be available for such use in any single urban region. The electric cars would not save energy overall relative to future internal-combustion subcompact cars, but they could bring about major reductions in petroleum consumption where recharge power is derived from other energy sources, as it is in St. Louis and, to a lesser extent, in Philadelphia. Air quality improvements due to electric car use would be modest in importance, because conventional cars replaced will be cleaner in the future, and non-automotive sources of air pollution will be relatively more important. The electric subcompacts will be 20 to 90 percent more expensive overall than conventional subcompacts until battery development significantly reduces battery depreciation costs.

5016 (TEC--75/006b) IMPACT OF FUTURE USE OF ELECTRIC CARS IN THE ST. LOUIS AND PHILADELPHIA REGIONS. VOLUME II. TASK REPORTS ON ELECTRIC CAR CHARACTERIZATION AND BASELINE PROJECTIONS. FINAL REPORT. Hamilton, W.F.; Eisenhut, J.C.; Sjovold, A.R. (General Research Corp., Santa Barbara, Calif. (USA)). Sep 1975. Contract E(04-3)-1119. 256p. Dep. NTIS $7.60.

Results are presented of a study of the projected effects of electric vehicles on energy use, the environment, and the economy of the two urban areas. Volume I contains an executive summary and a technical report, Volume II contains five task reports on electric car characteristics and baseline projections, and Volume III contains four task reports on impact analyses. The task reports in Volume II are on (1) characterization of battery-electric cars for future use; (2) population projections from 1980 to 2000; (3) transportation projections from 1980 to 2000; (4) electric energy projections from 1980 to 2000; and (5) economic projections from 1980 to 2000. A separate abstract for each section was prepared for ERDA Research Abstracts (ERA) and for Energy Abstracts for Policy Analysis (EAPA). (PMA)

5017 (TEC--75/006b, pp 44p, Task Report 1) CHARACTERIZATION OF BATTERY-ELECTRIC CARS FOR FUTURE USE IN THE ST. LOUIS AND PHILADELPHIA REGIONS. Hamilton, W.F. Sep 1975.

Impact of future use of electric cars in the St. Louis and Philadelphia regions. Volume II. Task reports on electric car characterization and baseline projections. Final report.

Electric cars for future use in St. Louis and Philadelphia are characterized to support subsequent analysis of their potential impacts. Like cars characterized previously for a study of impacts in the Los Angeles area, these cars are low-performance subcompacts weighing from 2200 to 3500 pounds; they can carry up to 4 passengers at freeway speeds, and offer urban driving ranges of 54 to 140 miles. In Philadelphia and St. Louis, where climatic conditions are much less moderate than in Los Angeles, average annual energy consumption of electric cars will be increased up to 10 percent by demands for heating and air conditioning, with consequent range losses which will moderately reduce applicability of the electric cars to daily driving patterns. A conventional subcompact with performance as low as the nearer-term electric car is also considered; its fuel economy, about 27 percent higher than that of the average subcompact, affords an appropriate basis for comparisons of energy consumption of electric and conventional cars.

5018 (TEC--75/006c) IMPACT OF FUTURE USE OF ELECTRIC CARS IN THE ST. LOUIS AND PHILADELPHIA REGIONS. VOLUME III. TASK REPORTS ON IMPACT AND USAGE ANALYSES. FINAL REPORT. Hamilton, W.F.; Eisenhut, J.C.; Fox, H.G.; Martinez, J.R.; Sjovold, A.R.; Tran, K.; Waller, W.E. (General Research Corp., Santa Barbara, Calif. (USA)). Sep 1975. Contract E(04-3)-1119. 338p. Dep. NTIS $10.60.

A study is presented in three volumes, the first containing a comprehensive account of the impacts that electric cars would have on energy use, the environment, and the economy in two urban areas, the remaining two volumes containing task reports documenting the analyses contained in the first volume. The four task reports contained in Volume III cover (1) energy impacts; (2) air quality impacts; (3) resource and environment impacts; and (4) economic impacts. A separate abstract for each of the four task reports was prepared for ERDA Research Abstracts (ERA) and for Energy Abstracts for Policy Analysis (EAPA). (PMA)

5019 (TEC--75/006c, pp 65p., Task Report 9) ECONOMIC IMPACTS OF ELECTRIC CARS IN ST. LOUIS AND PHILADELPHIA. Fox, H.G.; Waller, W.E. Sep 1975.

Impact of future use of electric cars in the St. Louis and Philadelphia regions. Volume III. Task reports on impact and usage analyses. Final report.

A study was made of the economic impacts that could be expected to accrue in the St. Louis and Philadelphia Regions in the event electric cars are substituted for internal-combustion-engine automobiles. Life-cycle costs are developed for average, conventional, and low-performance subcompact internal-combustion-engine automobiles and for electric cars with four different types of batteries of the 1980, 1990, and 2000 time periods. The impacts upon regional economic sectors that would be affected by electric car usage are also developed and are expressed as changes in employment, payrolls, and personal income. Findings from a previous electric car study pertaining to the Los Angeles region are presented for contrast and comparison. 3 figures, 33 tables.

5020 (TEC--75/006c, pp 120p., Task Report 7) AIR QUALITY IMPACTS OF ELECTRIC CARS IN THE ST. LOUIS AND PHILADELPHIA METROPOLITAN REGIONS, 1980--2000. Martinez, J.R.; Tran, K.T. Sep 1975.

Impact of future use of electric cars in the St. Louis and Philadelphia regions. Volume III. Task reports on impact and usage analyses. Final report.

A study was made of the air quality impact of replacing conventional heat engine passenger cars with electric vehicles in the St. Louis and Philadelphia regions for the years 1980, 1990, and 2000. Emissions from both stationary and mobile sources and air quality were estimated for each region with and without electric cars for these three years. In making these estimates, very high levels of electric car use were assumed: replacement of 20, 80, and 100 percent of the conventional passenger cars in 1980, 1990, and 2000, respectively. For both St. Louis and Philadelphia, the results show that use of electric cars would tend to reduce areawide emissions of total hydrocarbons and carbon monoxide. The reductions range from 6 percent in 1980 to 17 percent in 2000 for hydrocarbons, and from 10 percent in 1980 to 18 percent in 2000 for carbon monoxide. The overall effects on particulate emissions were essentially insignificant. Because of the greater demand for electricity induced by electric vehicles, emissions of sulfur oxides tended to increase. For Philadelphia the increases ranged from a maximum of 21 percent in 1990 to a minimum of 3 percent in 2000; for St. Louis, increases in sulfur oxides emissions ranged from 5 percent in 1980 to 14 percent in 1990. In the case of emissions of nitrogen oxides, electric vehicles produced imperceptible effects in Philadelphia. In St. Louis, nitrogen oxides increased 4 percent in 1980 and 9 percent in 1990, but decreased 6 percent in 2000, the increases being due to greater power plant emissions.

5021 (TEC--75/006c, pp 70p., Task Report 6) ENERGY IMPACTS OF ELECTRIC CARS IN ST. LOUIS AND PHILADELPHIA. Sjovold, A.R. Sep 1975.

Impact of future use of electric cars in the St. Louis and Philadelphia regions. Volume III. Task reports on impact and usage analyses. Final report.

Electric cars are projected to use primary energy more efficiently than the average future internal combustion engine (ICE) car, but less efficiently than subcompact ICE cars with which they are more nearly competitive in size and performance. At high electric car usage levels,

electrics would necessarily replace some of the larger, less-efficient ICE cars, and thereby provide some small savings in total primary energy consumption for automotive travel. Projected electric power generation capacity increases will be capable of supplying sufficient off-peak power to recharge a 100 percent electric car population in the year 2000. An approximately 80 percent electric car population in 1990 can be similarly accommodated. Recharge energy for higher levels of electric car use in St. Louis will initially come from coal-fired generation sources in 1980, and shift heavily (67 percent) to nuclear sources by 2000. In Philadelphia, 1980 recharge energy will come solely from oil-fired steam generation plants, and shift heavily (91 percent) to nuclear sources by 2000. These situations compare to that for Los Angeles where 1980 recharge energy comes solely from oil-fired steam, but less than 45 percent will come from nuclear sources in 2000. Consequently, relative savings in regional petroleum consumption are least in Philadelphia and Los Angeles in 1980, but greatest in Philadelphia in 2000. St. Louis offers the greatest relative petroleum savings in 1990, when Philadelphia and Los Angeles are in transition from oil-fired to nuclear generation sources.

5022 (TID/SNA--581) ENGINE ELECTRICAL POWER SOURCE, TRADE STUDY 419. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Apr 1970. Dep. NTIS $4.25.
ALTERNATORS;COMPARATIVE EVALUATIONS;ELECTRIC BATTERIES;FUEL CELLS;NERVA REACTOR

5023 (UCID--17098(Vol.1)) BATTERY-FLYWHEEL HYBRID ELECTRIC POWER SYSTEM FOR NEAR-TERM APPLICATION. VOLUME I. SYSTEM DESCRIPTION. Davis, D.; D.; O'Connell, L.G.; Warner, S.E.; Raynard, A.E.; Rowlett, B.H. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 15 Apr 1976. Contract W-7405-Eng-48. 52p. Dep. NTIS $4.50.
A description is given of a hybrid propulsion system design, based upon demonstrated technology, that will substantially improve performance, range, and consumer acceptability of a battery-powered electric vehicle. A newly demonstrated high-energy composite flywheel is coupled to an extremely simple, efficient, electro-mechanical transmission. Lead-acid batteries provide the prime power source. Interactive control of battery and flywheel drive power is provided by a versatile microprocessor-based power control unit. Efficient recovery of vehicle kinetic energy during braking, plus the energy base required to meet all high power transient demands, is provided by the flywheel. Battery demand is stabilized at a low average value resulting in improved battery performance through increases in both cycle life and available energy. Electric vehicle acceleration and range improvements due to the hybrid system described are predicted to be in excess of 80 percent for a vehicle operated in a stop-and-go commuter environment. This increase in performance is accompanied by a decrease in operating cost.

5024 (UCRL--52000-75-9, pp 20-25) LITHIUM--WATER--AIR BATTERIES FOR AUTOMOTIVE ENERGY. Sep 1975.
Lawrence Livermore Laboratory energy and technology review.
ELECTRIC-POWERED VEHICLES;LITHIUM-WATER-AIR BATTERIES;DESIGN;PERFORMANCE;FEASIBILITY STUDIES;PRIMARY-SECONDARY HYBRID BATTERIES

5025 (UCRL--52000-75-9) LAWRENCE LIVERMORE LABORATORY ENERGY AND TECHNOLOGY REVIEW. Carr, R.B.; Barnett, J.M.; Berlo, R.C.; McCaleb, C.S.; Prono, J.K. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Sep 1975. Contract W-7405-Eng-48. 30p. Dep. NTIS $4.00.
ENERGY;RESEARCH PROGRAMS;COAL GASIFICATION; METHANOL;AUTOMOTIVE FUELS;ELECTRIC-POWERED VEHICLES;LAWRENCE LIVERMORE LABORATORY

5026 (UCRL--77440) LITHIUM REQUIREMENTS FOR ELECTRIC VEHICLES USING LITHIUM-WATER-AIR BATTERIES. Cooper, J.F.; Borg, I.Y.; O'Connell, L.G. Behrin, E.; Rubin, B.; Wiesner, H. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 12 Nov 1975. Contract W-7405--Eng-48. 18p. (CONF-760112--2). Dep. NTIS $4.50.
From Symposium on United States lithium resources and requirements by the year 2000; Lakewood, Colorado, USA (22 Jan 1976).
The lithium--water--air battery is a new primary battery of such exceptional power and energy that it is a candidate to provide propulsion for electric automobiles of the future. In the electrochemical reaction involved, lithium, oxygen, and $CO_2$ are combined; $Li_2CO_3$ is left as a by-product to be removed from the battery and recycled. A subcompact car weighing 910 kg would transform 7.2 kg of lithium in traveling 320 km at 97 km/hr. At least an equal amount of lithium per car would be unavailable because of the need to recycle the by-product ($Li_2CO_3$). Thus, a minimum of 14.4 kg of lithium per car is required to support a transportation system based upon this power source. Assuming that, in the year 2000, 12 to 16 percent of all vehicles are powered by lithium--water--air batteries, we will need 234,000 to 425,000 metric tons of lithium. This amount is somewhat less than the total known U.S. lithium reserves; but, if the current rate of consumption of lithium for other purposes continues, the supply of lithium will have to be increased. 4 figures, 5 tables (auth)

5027 (UCRL--78066) SUPPLY AND DEMAND OF FUEL SOURCES FOR AUTOMOBILES. Anderson, C.J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 11 May 1976. Contract W-7405-Eng-48. 11p. (CONF-760342--1). Dep. NTIS $3.50.
From Symposium on alternate fuel resources; Santa Maria, California, USA (25 Mar 1976).
A review is given of the state of domestic oil depletion in context of projected world oil production. An optimized strategy for dealing with this problem is discussed. The strategy is based on the development of low cost synfuels and preparation for the introduction and utilization of these synfuels; i.e., smaller more efficient cars are needed that can utilize available synfuels. In addition, advanced batteries are required before electricity from coal and/or nuclear energy can be effectively utilized in transportation. Finally, the result of an economic analysis that indicates the nature of optimization of the overall strategy is given.

5028 ELECTRIC VEHICLES AND COMPONENTS. Battery Man; 19: No. 7, 22, 25(Jul 1977).
Plans for the manufacture of battery-powered buses in the U.S. are briefly recounted. The bus can reach a maximum speed of 40 mph over a range of 40 miles and easily keep up with center-city traffic. (RWR)

5029 BATTERY/GASOLINE POWER PROBABLE SOLUTION. Battery Man; 19: No. 6, 8, 10(Jun 1977).

This hybrid taxi starts moving with power from eleven 12-volt, 80-ampere lead--acid batteries. When the vehicle reaches a speed at which an i.c. engine operates efficiently, that engine takes over. Thus, the taxi runs on pollution-free batteries in center city. 1 figure. (RWR)

5030 CONTROL SYSTEM FOR BATTERY HYBRID SYSTEM. Shibata, T.; Omae, T. (to Agency of Industrial Science and Tech.). US Patent 4,025,860. 24 May 1977. Priority date 14 Sep 1974, Japan. 8p.

An electric auto power supply has an energy battery which is capable of discharging a current for a comparatively long period of time and high in energy density, and a power battery which is capable of discharging a current of a comparatively high amperage and high in power density. The energy battery and the power battery are connected respectively by way of switching means in parallel relation to each other, so as to be used as a power source of an electromobile. The current discharged from these batteries is controlled, such that a current required for the travelling of the electromobile, which is dependent upon the travelling conditions, is supplied simultaneously from both batteries, or separately from individual batteries, or otherwise only from one battery, while a current is being charged to the other battery, thus extending the possible mileage range of the electromobile.

5031 BATTERY CONTROL SYSTEM FOR BATTERY OPERATED VEHICLES. Finger, E.P.; Marwell, E.M. (to Curtis Instruments, Inc.). US Patent 4,012,681. 15 Mar 1977. Filed date 3 Jan 1975. 6p.

A system is disclosed for monitoring the state of charge of batteries in a fleet of electrically powered vehicles. Each battery has associated with it an integrator module which registers both the depletion and charging of the battery. While the battery is in use in the vehicle, a portion of the current flowing from the battery is sent to the integrator module which registers the current depletion. A readout circuit is also coupled to the integrating device for indicating the condition of the battery while it is in the vehicle. When the battery reaches a predetermined low state of charge, circuitry provided for detecting this condition provides a prewarning signal and on further discharge disables nonessential auxiliary functions in the vehicle, leaving only those systems working which are necessary in order for the driver to be able to return to a battery charging station. At the charging station, the integrator module and the battery are removed from the vehicle and connected at the charging station. During charging, the integrator module is coupled to the charger and a portion of the current leaving the charger passes through the integrator module providing continuous display of the state of charge and information to regulate the charge rate and terminate charge when appropriate ampere hours have been returned to the battery.

5032 ENERGY EXCHANGER FOR AN ELECTRICAL VEHICLE. Lombard, C. (to Regie Nationale des Usines Renault). US Patent 4,010,407. 1 Mar 1977. Priority date 7 Mar 1974, France. 6p.

An energy exchanger for a battery driven vehicle comprising two rotatable electrical machines connected on the same shaft, one of high voltage, the other of low voltage. The electrical machines can each be operated in generator or motor modes and the machines are electrically connected together to the battery on a vehicle via an electrical control circuit such that the machines exchange energy between themselves and the battery, both to drive the vehicle by battery drain and to recharge the battery when the vehicle is decelerating. The battery can be recharged from an external power supply via the machines which then operate in generator mode.

5033 PM OWNERS REPORT: ELECTRIC CARS FINE FOR IN-TOWN COMMUTING, BUT LOTS OF KINKS TO WORK OUT. Lamm, M. Pop. Mech.; 147: No. 3, 90-93(Mar 1977).

A summary is given of electric car owner reports resulting from a nationwide survey based on 465,598 owner-driven miles, and a typical sampling of the comments from the 1,000 electric car owners surveyed are presented. Complaints included poor performance, rough ride, battery replacement costs, poor battery performance in cold weather, and poor ventilation systems. Several types of homebuilt electric vehicles and converted gasoline automobiles are described. (PMA)

5034 WHY WAIT FOR THOSE 'ALWAYS-JUST-ROUND-THE-CORNER' POWER SOURCES. Electr. Veh. Batteries; 63: No. 1, 14-16, 18, 28(Mar 1977).

The article is an extended summary of an address to the Fourth International Electric Vehicle Symposium in Dusseldorf, about energy sources as they relate to electric vehicles. As a standard for comparison, the author took the ESB EV-106 battery, a 6-volt lead-acid type in a polypropylene case, which was designed specifically for use in golf carts; it came closest to fulfilling the needs of electric cars in terms of the ''off-the-shelf hardware''. It would deliver 75 amps continuously for 106 minutes. The one hour rate was more severe but it had a specific energy of 24 Wh per kg. The EV-106 has a cycle life of 400, initial cost of $40/kWh, and a lifetime cost of 10 cents/kWh. The author considers that there is an 85% probability of improving the lead-acid type to give 40 Wh/kg (one-hr rate) a cycle life of 800, initial cost of $45/kWh, and a lifetime cost of 5.6 cents/kWh. The only new type given as much as ''50% probability'' is the nickel-zinc type which promises 60 Wh/kg (one-hr rate), a cycle life of 10 cents/kWh. The zinc-chlorine and the sodium-sulfur types are discussed, but their likelihood of commercialization in the near term is viewed as unlikely.

5035 STORED ENERGY: THE STATE OF THE ART. Battery Man; 19: No. 3, 14-15, 17, 23(Mar 1977).

The concept of energy storage and its necessity because of decling energy sources are outlined. Significant applications for energy storage are electric-powered vehicles and load leveling. These are discussed at the popular level. Prospects for development are expressed. (RWR)

5036 ELECTRICALLY PROPELLED VEHICLE. Christianson, C.C.; Bourke, R.F. (to Gould Inc.). US Patent 4,008,423. 15 Feb 1977. Filed date 11 Feb 1975. 28p.

A propulsion system for an electrical vehicle includes a linear proportional controller operable in a plurality of modes for

operating a dc drive motor via power derived from a propulsion battery. Low speed operation is achieved in an armature control mode wherein the controller is interposed between the propulsion battery and the motor armature while the motor field is coupled directly across the battery. High speeds are attained in a field control mode wherein the controller is interposed between the battery and motor field while the armature is coupled directly across the propulsion battery, thereby eliminating controller losses from the high current armature circuit. Switching between modes is achieved in a manner which minimizes stress on the switching elements. The controller is also adapted to operate in a charger mode wherein unregulated dc power is fed to the controller which functions to regulate the charge provided to the battery. Overall efficiency is increased by use of a dual chopper as a power modulator element. The circuit further includes protection means for controlling or preventing operation under conditions wherein circuit elements might be damaged.

5037 BATTERY VEHICLE FLEET DEMANDS CAREFUL MAINTENANCE. Mason, R.H. Coal Min. Process.; 14: No. 2, 64-67(Feb 1977).

Dependence on battery-powered equipment as the primary coal haulage system necessitates extremely close consideration of a maintenance program that provides optimum performance, extended battery service life, and minimum service cost. This article describes how Kessler Coals Inc. has achieved these maintenance objectives for its fleet of 20 battery vehicles performing a multitude of tasks in addition to coal haulage at its two mines near Whitesville, W.Va. The company's equipment standardization, record keeping, battery maintenance, battery equipment and haulage plan are highlighted.

5038 NOTEWORTHY ACHIEVEMENTS INSTEAD OF SENSATIONS. A REPORT ON THE FOURTH INTERNATIONAL ELECTRIC-VEHICLE SYMPOSIUM. Leonhard, A. (GES Gesellschaft fuer Elektrischen Strassenverkehr m.b.H., Duesseldorf (Germany, F.R.)). Elektrizitaetswirtschaft; 76: No. 1, 6-9(Jan 1977). (In German).

4 figs..

Increasing energy and environmental problems all over the world have led to increasing activity in the field of the electric vehicle for densely populated areas. Now a balance has been drawn up: 600 experts 28 countries met in Duesseldorf for the Fourth international electric-vehicle symposium in 1976. It was arranged by the Unipede, Paris, and the Electric Vehicle Council, New York; the hosts were the Vereinigung Deutscher Elektrizitaetswerke, VDEW. The author gives a short review of the five subject headings dealt with at the Symposium.

5039 PRELIMINARY RESULTS OF TRIALS OF ELECTRICALLY DRIVEN COMMERCIAL VEHICLES. Altendorf, J.P. (Volkswagenwerk A.G., Wolfsburg (Germany, F.R.)); Werner, F. (Daimler-Benz A.G., Stuttgart (Germany, F.R.)); Stracke, K.H. (GES Gesellschaft fuer Elektrischen Strassenverkehr m.b.H., Duesseldorf (Germany, F.R.)). Elektrotech. Z., A; 98: No. 1, 44-50(Jan 1977). (In German).

From 4. international electric vehicle symposium; Duesseldorf, Germany, F.R. (31 Aug - 2 Sep 1976).

5 figs.; 5 tabs.; 4 refs..

In a large test 50 electric transporters (20 VW and 30 DB) together with the accompanying batteries and supply components, were examined from the point of view of their application, with the object of obtaining technical and economic data for further development. In addition to giving the technical design of the vehicles a report is presented on the first results of ordinary everyday use. Except for initial difficulties the vehicles tested gave satisfactory results. But it was found that, in order to confirm the data, experience and statistical data, testing must be carried out on a wider basis.

5040 EXPERIENCE GAINED IN LARGE-SCALE TESTS WITH AN ELECTROBUS. Hagen, H.; Zelinka, R. (Maschinenfabrik Augsburg-Nuernberg (M.A.N.) A.G., Muenchen (Germany, F.R.)). Elektrotech. Z., A; 98: No. 1, 54-60(Jan 1977). (In German).

4 figs.; 4 tabs.; 3 refs..

In an extensive test 20 electric busses are running, half of them having separately excited or series excited motors. A report is given on experience gained in line operation since the end of 1974 with the vehicle, the drive and the battery. Up to the end of 1975 the buses travelled about 825,000 km.

5041 DESIGN OF ELECTRIC COMMERCIAL VEHICLES FOR PRODUCTION. Harding, G.G. Warrendale, PA; Society of Automotive Engineers (1977). 10p. (CONF-770205--58).

From Conference of the SAE International Automotive Engineering Congress and Exposition; Detroit, Michigan, USA (28 Feb 1977).

Development of high performance electric vehicles has been pursued both by simple conversions from standard gasoline vehicles, and by designing a purpose-built vehicle in the form of a taxi incorporating novel features. By combining the lower cost of the former method with the greater efficiency of the latter, the Mark III Lucas electric vehicle has been evolved based on a standard van, providing 1 ton payload capacity. The compact drive package can be fitted to a variety of vehicles at the initial manufacturing stage. Some of the implications for distribution and servicing of quantity-produced electric vehicles are considered.

5042 BATTERY POWERED JEEP AND VAN PERFORMANCE. Dowgiallo, E.J. Jr.; Snellings, I.R.; Blake, W.H. Warrendale, PA; Society of Automotive Engineers (1977). 8p. (CONF-770205--59).

From Conference of the SAE International Automotive Engineering Congress and Exposition; Detroit, Michigan, USA (28 Feb 1977).

A postal jeep and a commercial delivery van were evaluated. Energy data from operation over a test loop and various grades are presented for zero to 15 mph start/stop and 30 mph range runs. Test results are summarized in a graph for prediction of remaining miles based on route terrain. Jeep regenerative braking is discussed. A high power electrical simulator was used to reproduce a mountainous terrain load profile. The simulator was programmed with magnetic tapes made up from actual field recordings. This verified calculations, gave additional battery information and eliminated the need for a mountainous terrain test track.

5043 ACTUAL OPERATING EXPERIENCE OF LEAD-ACID BATTERIES FOR ELECTRIC MILK DELIVERY CARS. Nagano, T.; Maegawa, O.; Kamada, K.; Okazaki, I. Warrendale, PA; Society of Automotive Engineers (1977). 7p. (CONF-770205--60).

From Conference of the SAE International

Automotive Engineering Congress and Exposition; Detroit, Michigan, USA (28 Feb 1977).

An electric milk delivery car, using lead-acid batteries as the power source, has been put into practical use for about four and a half years. From the data obtained during these years, its feasibility was confirmed and some problems in battery handling were made clear to make most effective use of battery.

5044 CLEAN TRANSPORTATION FOR NEW TOWNS: DAIHATSU ELECTRIC VEHICLES IN THE SENBOKU AREA. Honda, S.; Sugitani, M.; Yumoto, I.; Kawakatsu, S. Warrendale, PA; Society of Automotive Engineers (1977). 13p. (CONF-770205--61).

From Conference of the SAE International Automotive Engineering Congress and Exposition; Detroit, Michigan, USA (28 Feb 1977).

Senboku is the name of a new town which is expected to become a model area of clean transportation in Japan. The transportation of peoples and goods would be systematized, and some kinds of electric vehicles would be used as its means with the valuation of non-pollution. Inside of Senboku area, a joint home delivery experimental test, using our newly developed electric cab-van of DAIHATSU ES40V, was finished. The electric propulsion systems, specification and performance of ES40V are discussed as well as its quick-charging system.

5045 HIGH ENERGY NICKEL--ZINC BATTERY FOR ELECTRIC VEHICLES. von Krusenstierna, O.; Reger, M. Warrendale, PA; Society of Automotive Engineers (1977). 9p. (CONF-770205--62).

From Conference of the SAE International Automotive Engineering Congress and Exposition; Detroit, Michigan, USA (28 Feb 1977).

Before far-term high energy electric vehicle batteries are developed, near-term lead-acid and intermediate batteries with energy densities 40 to 80 Wh/kg can meet the energy demands of a large number of commuter and delivery cars. A new nickel-zinc battery is described with energy densities of 50 to 80 Ah/kg depending on the choice of nickel cathodes. A vibration charging technique completely eliminates the zinc dendrite and shape effects, and the nickel cathodes therefore determine the lifetime. A 2 kW battery was deep cycled for 1200 cycles, and traction cells up to 350 Ah were field tested in vehicles.

5046 CHARGE-DISCHARGE BEHAVIOR OF THE C.G.E. CIRCULATING ZINC--AIR VEHICLE BATTERY. Appleby, A.J.; Jacquelin, J.; Pompon, J.P. Warrendale, PA; Society of Automotive Engineers (1977). 10p. (CONF-770205--64).

From Conference of the SAE International Automotive Engineering Congress and Exposition; Detroit, Michigan, USA (28 Feb 1977).

The primary unit of the C.G.E. zinc--air electric vehicle battery has been described in previous publications. It consists of a constant cross-section tubular fuel cell using zinc powder in circulating 12 N KOH solution. All the reaction product (zincate) is maintained in colloidal solution. The system is capable of lifetimes in excess of 1,800 hours and will be of low cost. A discussion is given of the technical aspects of recharge of the system, which, in contrast to the primary cell, is still in the laboratory engineering stage. The limitations of the system are discussed and the overall performance based on different parameters is given. A number of different economic options are examined.

5047 ELECTRIC CAR MAY BE ENERGY SAVER IN 2001. Charlesworth, G. (Open Univ., Milton Keynes, Eng.). Electr. Rev. (London); 199: No. 23, 16-17(10 Dec 1976).

A comparative evaluation is made in terms of primary energy efficiency of internal combustion engine automobiles and electric-powered vehicles for both present and projected future models. The sodium sulfur battery appears to be the front runner among battery candidates and is expected to achieve an energy density of about 550 MJ/ton. It is predicted that electric cars will be on the order of 1.7 times more efficient than combustion powered automobiles in their use of primary energy when moving the average payload. (PMA)

5048 ELECTRICAL CARS: MORE PUSH DOWN UNDER. Whitford, D. (Flinders Univ., South Australia). Electr. Rev. (London); 199: No. 22, 34(3 Dec 1976).

A brief description is given of advances in the design of electric vehicles. Transmissions and control systems were redesigned so that the mechanical requirements of the vehicle road wheels are matched to those of the electric motor, and the electrical requirements of the motor are matched to those of the power source. A pre-selector unit controls the battery voltage in 12 V increments to track the back e.m.f. of the motor as the vehicle speed varies. (PMA)

5049 ELECTRIC VEHICLE DEVELOPMENT. Automot. Eng. (N.Y.); 84: No. 8, 39-43(Aug 1976).

Recent technological advances in electric-powered vehicles are reviewed. Although the electric battery remains the limiting factor, vehicle range can be improved by reducing the peak current drains during acceleration, by semiconductor interrupted control methods, and by regenerative braking. Lead-acid batteries and nickel-cadmium batteries are compared, and hybrid systems with flywheels are considered. Performance test results for an experimental impact passenger car are given. (PMA)

5050 LEAD--OXYGEN DC POWER SUPPLY SYSTEM HAVING A CLOSED LOOP OXYGEN AND WATER SYSTEM. Britz, W.J.; Boshers, W.A.; Kaufmann, J.J. US Patent 3,964,928. 22 Jun 1976. Filed date 27 Dec 1974. 8p.

An electrical power system is described for supplying dc power to electrically motorized vehicles, emergency standby sources, and the like. A lead-oxygen battery cell used as a source of dc power includes a positive charging grid, a conventional negative electrode, a positive discharging electrode, and a teflon membrane member coated with a catalyst contained in an atmosphere of oxygen which is admitted to the cell through the teflon membrane. Oxygen is given off during the charging cycle and is compressed in a storage tank for re-use during each duty cycle providing a closed system wherein contamination is minimized and a long-life cycle can result.

5051 ECONOMY OF OPERATION OF ELECTROCHEMICAL STORAGE DEVICES AS COMPARED TO CONVENTIONAL PEAK POWER GENERATORS. Fischer, W. (Brown, Boveri und Cie A.G., Heidelberg (F.R. Germany). Zentrales Forschungslabor). Elektrotech. Z., A; 97: No. 6, 357-359(Jun 1976). (In German).

2 figs.; 1 tab.; 11 refs..

An uniform calculation method can be used to compute power production costs for different peak power generators. For this purpose the investment and the maintenance costs of power dependent and energy dependent components are

considered separately. The power production costs calculated in this way are compared for different peak power generators (pumped storage, gas turbine with and without compressed air reservoir, steam turbine with steam reservoir, electrochemical batteries). Furthermore, it is shown that the economic valuation is only very slightly dependent on the chosen boundary conditions (e.g. fuel cost, load factor, number of charge discharge cycles per day). Batteries can be installed close to the consumers or at the base power station. The first solution is economically feasible only at discharge periods up to about three hours.

5052 ELECTRIC-POWERED VEHICLE WITH INFINITELY VARIABLE SPEED TRANSMISSION. Dittrich, O. (P.I.V. Antrieb Werner Reimers K.G., Bad Homburg (Germany, F.R.)). Foerdern Heben; 26: No. 7, 725-728(Jun 1976). (In German).
8 figs..
An infinitely variable speed transmission for electric-powered vehicles is described. This type of transmission enables torque conversion in the range 1:4. Thus, the tractive power required for starting and for driving up slopes is provided, while the driving speed on level ground is also increased. The infinitely variable transmission is adjusted at all speeds by a centrifugal speed governor so that the speed and thus also the current of the motor is kept constant. This working point is chosen in the most suitable region with regard to motor efficiency, heating-up and battery capacity.

5053 LOW-CAPACITY BACK-UP POWER SUPPLIES. Revol, R.; Girard, J. (Serv. du Control Tech. des Telecomm., Issy-les-Moulineaux, France). Commutation Electron.; No. 53, 53-56(Apr 1976). (In French).
The design and uses of continuous power supplies in association with various types of telecommunication equipment are discussed. A comparative study of traditional electrochemical sources shows the difficulty of choosing from among commerical products. This study is rounded off with the description of prototypes using integral batteries.

5054 SPOT WELDING USING STORAGE BATTERIES AS AN ENERGY SOURCE. Hamasaki, M.; Matuoka, S. (Gov. Ind. Res. Inst., Shikoku, Japan). Trans. Jpn. Weld. Soc.; 7: No. 1, 3-8(Apr 1976).
The duty cycle of a spot welder is 10% at most; therefore, its continuous capacity is not large. On the other hand, a large-capacity welder is needed, because a large amount of current flows even if for a short time. To solve this problem, the authors tried to develop a new method in which batteries are inserted in the primary circuit of the transformer and a large ac current is obtained in the secondary. In this case, energy is stored in the batteries, over a relatively long time, and this energy is used to perform spot welding. There are two methods for charging the batteries, one in which charging is made off time and the other in which charging is made at night. Spot welding of 1.0, 2.3 and 3.2 mm thick mild steel plates was tried using both charging methods and resulted in successful welds.

5055 OPTIMUM VOLTAGE OF A BATTERY FOR EMERGENCY ILLUMINATION. Outulny, K. Elektrotech. Obz.; 65: No. 3, 160-162(Mar 1976). (In Czech).
The dependence of the investment costs on the choice of the voltage of a battery for emergency illumination is considered. The resultant relations are plotted on a graph, from which it is possible to find the optimum voltage of the battery at which the investment costs are lowest.

5056 CAN LEAD--ACID BATTERIES SHAVE UTILITY PEAKS. Smock, R. Electr. Light Power (Boston); 54: No. 2, 39-40(23 Feb 1976).
Lead-acid battery technology--either state-of-the-art or advanced--has become a serious contender as a utility storage/peaking system. Its benefits could permit more efficient use of existing base-load generating equipment, reducing fuel requirements; they could minimize the need for new peak-power rotating equipment installations, reducing fuel usage and siting concerns; they could be located either in urban or suburban locations, near either the generation or use points. Such installations would be quiet and contained in either new or existing buildings, built or modified at minimal cost; they would require minimal regular maintenance, involve no fuel deliveries, ash disposal, or noxious combustion emissions.

5057 CARDIAC PACEMAKER. Kolenik, S.A. (to Arco Nuclear Co.). German(FRG) Patent 2,524,815/A/. 2 Jan 1976. 19p. (In German).
5 figs..
The construction of a cardiac pacemaker is described which is characterized by particularly small dimensions, small weight and long life duration. The weight is under 100g, the specific weight under 1.7. Mass inertia forces which occur through acceleration and retardation processes, thus remain below the threshold values, above which one would have to reckon with considerable damaging of the surrounding body tissue. The maintaining of small size and slight weight is achieved by using an oscillator on COSMOS basis, where by considerably lower energy consumption, among others the lifetimes of the batteries used - a lithium anode with thionyl chloride electrolyte - is extended to over 5 years. The reliability can be increased by the use of 2 or more batteries. The designed dimension are 20x60x60 $mm^3$.

5058 REVIEW OF CANDIDATE BATTERIES FOR ELECTRIC VEHICLES. Gross, S. (Boeing Aerospace Co., Seattle). Energy Convers.; 15: No. 3/4, 95-112(1976).
Short summaries are presented of most of the battery systems that can be considered for electric vehicles. Many little-known systems are included, some with little or no experimental background, and thus are worth considering for future research. Electric vehicle battery requirements are postulated; on the basis of these requirements the battery candidates are evaluated for their near-term and long-term prospects. 204 references

5059 GEW COLOGNE ARE TESTING NEW ELECTRIC-POWERED VANS FOR URBAN USE. Seidel, S. Staedtetag; No. 5, 272-274(1976). (In German).
3 figs..
Electric-powered vehicles offer a way to alleviate the pressure on the environment from fumes and traffic noise. The use of these vehicles is of particular interest for service enterprises in towns of a larger size. In the FRG, the Gesellschaft fuer elektrischen Strassenverkehr mbH, Duesseldorf (GES), on behalf of the Bund and the Land North Rhine-

Westphalia, is concerned with the problematic points in the development of electric-powered vehicles and their use. At the moment, 30 Mercedes-Benz and 20 VW vans, converted to electric drive, are tested in everyday-routine. The GEW participates in this test program with 2 electro-vans of the type Mercedes-Benz LE 306. Technical data of these vehicles are presented. The aim of the test is to gain experience on the use of electric-powered vehicles and to supply the foundation for an economical mass production. Energy costs for the operation of the vehicles are at present DM 6.30/100 km.

5060 ELECTRIC VEHICLES IN COMMERCIAL TRANSPORT. Garrett, K. Automot. Eng. (London); 1: No. 6, 59-60(1976).

An electric-powered van, the Chrysler (UK) Silent Karrier, is described. The van has a payload of 1780 Kg, is capable of speeds up to 65 Km/h, and is powered by lead-acid batteries. A discussion is given of battery life and weight, vehicle design considerations, and vehicle operation. (PMA)

5061 SMALL ELECTRIC VEHICLE CONSIDERATIONS IN VIEW OF PERFORMANCE AND ENERGY USAGE. Yew, M.C.; McCulloch, D.E. (General Motors Corp., Warren, MI). pp 363-368 of Eleventh intersociety energy conversion engineering conference. Vol. I. New York; American Institute of Chemical Engineers (1976).

From 11. intersociety energy conversion engineering conference; State Line, Nevada, USA (12 Sep 1976).

See CONF-760906--P1.

Present and projected technology is covered on batteries, drive systems, packaging and accessories as it relates to small electric vehicles. Energy usage is compared between an electric vehicle and its internal combustion (IC) engine counterpart. It was concluded that even with Zn/Ni-oxide batteries, the performance and range of electric vehicles would still be rather modest in comparison of current IC engine vehicles. However, should no substantial new oil reserves be discovered, and should no low cost synthetic fuel be produced in quantity due either to capital requirements or technological difficulties, an advanced electric vehicle could become a viable second car in a two-car family.

5062 HIGH POWER DENSITY BIPOLAR LEAD-ACID BATTERY FOR ELECTRIC VEHICLE PROPULSION. Kassekert, D.W.; Isenberg, A.O.; Brown, J.T. (Westinghouse Electric Corp., Pittsburgh). pp 411-417 of Eleventh intersociety energy conversion engineering conference. Vol. I. New York; American Institute of Chemical Engineers (1976).

From 11. intersociety energy conversion engineering conference; State Line, Nevada, USA (12 Sep 1976).

See CONF-760906--P1.

A study was conducted to test the concept of using bipolar lead-acid batteries for electric vehicle propulsion. The goal of an experimental program was the construction and testing of a battery of sufficient size to permit valid extrapolation to larger size batteries. Peak specific power figures of over 200 watts per pound were achieved, and the specific energy of a bipolar battery was 12 to 13 watt hours per pound at the two hour discharge rate. It was considered that such a new battery system could be used as power source for buses, service vehicles, and personal commuter cars, with moderate cruising ranges of approximately 30 miles (48.27 km) but with good acceleration and hill climbing capability. It is hypothesized that the bipolar battery concept will also allow rapid battery recharge to extend the cruising range. A vehicle mission study was conducted using computer programs developed and verified for the various types of vehicles systems on other programs. The urban area of Seattle, Washington, was chosen for the mission studies, and terrain data on actual urban bus and suburban commuter vehicle routes were obtained. These data were combined with the performance data of prototype bipolar lead acid batteries. Vehicle system performance for various missions was computed and is reported.

5063 AMBIENT TEMPERATURE ELECTRIC VEHICLE BATTERIES BASED ON LITHIUM AND TITANIUM DISULFIDE. Gaines, L.H.; Francis, R.W.; Newman, G.H.; Rao, B.M.L. (Exxon Research and Engineering Co., Linden, NJ). pp 418-423 of Eleventh intersociety energy conversion engineering conference. Vol. I. New York; American Institute of Chemical Engineers (1976).

From 11. intersociety energy conversion engineering conference; State Line, Nevada, USA (12 Sep 1976).

See CONF-760906--P1.

Work in the $Li/TiS_2$ battery system was directed toward achieving the performance levels required for electric vehicle propulsion. Advances have been made in several areas: (1) the development of a practical $TiS_2$ cathode structure with high material utilization and excellent rate capability; (2) the development of lithium compatible electrolyte systems with extended cycle life; and (3) the demonstration in realistic laboratory test cells of over 250 deep discharge, high rate cycles. The predicted energy density of the $Li/TiS_2$ system in the electric vehicle application is on the order of 130 Wh/kg. This energy density is high enough to achieve a practical urban vehicle with a range of 160 km (100 miles). Based on the encouraging results obtained, development of the $Li/TiS_2$ system is proceeding with the specific goals of, first, the development of a more stable electrolyte suitable for large battery systems; second, determining optimum designs within the required economic and technical constraints; and, third, demonstrating batteries sized for vehicular use.

5064 ELECTRIC VEHICLE PERFORMANCE WITH ALTERNATE BATTERIES. Sudar, S.; Thomson, W. (Atomic International Div., Canoga Park, CA). pp 424-429 of Eleventh intersociety energy conversion engineering conference. Vol. I. New York; American Institute of Chemical Engineers (1976).

From 11. intersociety energy conversion engineering conference; State Line, Nevada, USA (12 Sep 1976).

See CONF-760906--P1.

A preliminary study was made of the performance of electric vehicles in support of a research and development program on advanced electric storage batteries. The electric vehicles studied were a 1134 kg (2500 lb) commuter car and a 3175 kg (7000 lb) van. Each was considered as an all-electric vehicle and also as a hybrid. Performance data calculated were range, acceleration, gradeability, and top speed. Advanced batteries having energy densities from 1.19 to 5.95 x $10^5$ J/kg (15 to 75 Wh/lb) were considered. Two such advanced batteries were considered; one was a lithium-iron sulfide design while the other was a zinc-nickel oxide design that features a rotating shutter.

5065 COMPUTER STUDY OF BATTERY ENERGY STORAGE AND POWER CONVERSION EQUIPMENT OPERATION. Beck, J.W. (Electric Power Research Inst., Palo Alto, CA); Carroll, D.P.; Gareis, G.E.; Krause, P.C.; Ong, C.M. IEEE Trans. Power Appar. Syst.; PAS-95: No. 4, 1064-1072(1976). From IEEE PES winter meeting and Tesla symposium; New York, NY, USA (25 Jan 1976).

Results are presented and discussed from a computer simulation of a battery energy storage/converter system connected to a representative utility substation. Switching of load, voltage waveforms, voltage levels, fault conditions, and power flow reversal are investigated for both line- and forced-commutated converters in the application. The interactions among the battery, the converter and its controls, and the substation are discussed. The investigations pointed out areas in which further consideration must be given to component selection for the battery/utility interface equipment, for example, dc reactor sizing, harmonic filtering, power factor control, thyristor firing control, and dc current interruption. 17 figures.

5066 PURPOSE-BUILT ELECTRIC TAXI. Warner, P. (David Ogle, Ltd, Letchworcs, Eng.). SAE Prepr.; No. 760124, 1-5(1976).

A prototype electric taxi was designed that is 3 ft shorter than the traditional London taxi, and the cab only 1 1/2 in. wider. Five of these vehicles would fit in the parking space required for four London taxis. Testing to date indicates that the purpose built electric taxi will have fuel costs per mile equivalent to 1/5 of the cost of a diesel taxi.

5067 COPPER ELECTRIC TOWN CAR. Pocobello, M.; Armstrong, D. SAE Prepr.; No. 760071, 1-10(1976).

The Copper Electric is a two-passenger prototype powered by eighteen lead--acid, six-volt batteries and driven by a separately-excited motor driving through a fixed-ratio transfer case and a spiral bevel gear set to the front wheels via independent axle shafts. The transfer case incorporates a toothed belt drive capable of handling maximum motor torque. The overall drive ratio is 4.95:1, resulting in an N/V ratio of 71.3. Range and performance targets are a maximum speed of 55 mph, acceleration to 30 mph in 12 s, range at 40 mph--120 miles and range in simulated city driving--74 miles.

5068 FUTURE ROLE OF ELECTRIC LAND TRANSPORTATION IN THE UNITED STATES. Hagey, G.; Hamilton, W. SAE Prepr.; No. 760118, 1-7(1976).

Electrification of land transportation, primarily automobiles, will be important to conserve petroleum before the year 2000. Even with existing battery technology, electric cars would be adequate for significant urban use as second cars, and with advanced batteries they could do much more, bringing about large petroleum savings in cities relying on coal or nuclear electric power, plus modest improvement of air quality. Overall costs of auto operation would be increased, however, and availability of some battery materials is limited.

5069 STUDY OF THE ENERGY UTILIZATION OF GASOLINE AND BATTERY-ELECTRIC POWERED SPECIAL PURPOSE VEHICLES. Sheridan, D.C.; Bush, J.J.; Kuziak, W.R. Jr. SAE Prepr.; No. 76011, 1-17(1976).

The guidelines of this study restricted it to three special-purpose cars that are smaller and have lower performance than conventional sub-compact cars and a delivery van. The most important guideline of the study required the performance levels and load carrying capacity of the gasoline and electric-powered vehicles to be the same. The results of the study indicate that a lead--acid-battery-powered, two-passenger shopper vehicle with a 40 km range consumed about 90% more petroleum per kilometer of driving than does its spark ignition engine powered counterpart. With coal as the prime source, they consume about the same amount of energy. Increases in desired range, performance and vehicle size beyond that of the shopper increase the electric vehicle energy consumption with respect to the gasoline-powered version. 17 refs.

5070 TROLLEY-WIRE-OPERATED UNDERGROUND LOCOMOTIVE WITH MANUAL AND REMOTE CONTROL, INCLUDING FULLY AUTOMATIC CONTROL AND SPEED REGULATION. Mittmann, U. AEG-Telefunken Prog.; No. 4, 128-132(1976).

AEG-TELEFUNKEN has supplied 16 trolley-wire-operated locomotives, Type HF 3 D, with manual and remote control, for a coal mine in the Ruhr District. The locomotives are equipped with an electronic controller. Since they were put into service in 1975, they have been meeting the targeted transportation objectives for a fully automatic underground haulage system.

5071 POST OFFICE TRIES LUCAS ELECTRICS. Baker, A. Automot. Eng. (London); 1: No. 1, 54(Oct 1975).

Ten Bedford vans, with Lucas electric traction equipment in place of the standard engine/gearbox group, are being put into service by the Post Office (United Kingdom). The vehicles, based on the CF one-ton van, are of two types--one for mail collection and delivery and the other for the telecommunications engineering service. Initially, the former will be operating in central London, to gain experience in dense traffic, and the latter, in the Stevenage area, where more rural conditions prevail. Polypropylene-case lead--acid SLI (Starting--Lighting--Ignition) batteries are used. The traction motors are rated at 37.2 kW. The maximum level-road speed is around 89 km/h and the acceleration from rest to 48 km/h is quite brisk, taking about 10 seconds. A regenerative braking system is fitted as a means of extending the range and increasing the life of the wheel brakes. An interesting feature of the system is that the regeneration is in two stages. The first stage comes in on over-run, when the driver lifts completely off the accelerator, and gives an equivalent retardation to engine braking. Light pressure on the brake pedal gives the second stage of regenerative braking, and heavier pressure brings in the wheel brakes. The first-stage regeneration cuts out automatically below 6.5 km/h to allow the vehicle to coast, the analogy here being with declutching.

5072 NEW GENERATION OF COMBINATION LOCOMOTIVES FOR UNDERGROUND MINING. Blutreich, J.N. (Ashland Div., Natl. Mine Service Co.). Min. Congr. J.; 61: No. 8, 44-7(Aug 1975).

Description of locomotives using overhead power or batteries as desired. MINING;ELECTRIC-POWERED VEHICLES;LEAD-ACID BATTERIES;USES; BATTERY CHARGING

5073 SELECTION OF THE PARAMETERS OF AN ACCUMULATOR POWER PLANT FOR AN ELECTROMOBILE. Listvinskii, M.S.; Kurzukov, N.I.; Pole, V.G.; Tyutryumov, O.S. Avtomob. Prom-st.; No. 8, 15-16(Aug 1975). (In Russian).

The selection of optimum variants of the battery power plant for an electric-powered automobile of 0.5 to 4 ton carrying capacity on the basis of modern domestic industrial batteries was studied. The basic criteria for rating the properties of the power plant were the weight ratio G/sub b//G/sub e/, where G/sub b/ = weight of the traction battery and G/sub e/ = total weight of the automobile, and the range L of the vehicle without additional battery charging. The study comprised experiments and calculations of power plant variants based on modern alkaline and acid batteries. The alkaline batteries were found to possess the highest energetic parameters, i.e., traction battery weight 24.7 to 37.4 percent of total weight, fuel distance 60 to 80 km on 1000 m distance at 60 km/hr speed, load capacity depending on the weight of hood, chassis and electric equipment 500 to 800 kg. Recommended variants of battery power plants for electric-powered automobiles of up to one ton capacity and designed for 40 km/hr maximum speed are tabulated.

5074 PROGRESS ON VOLTMOBILES. Callahan, J.M. Automot. Ind.; 153: No. 2, 26-27(15 Jul 1975).

Two new electric passenger automobiles, based on quite different approaches, are described. The Copper Electric Town Car, developed for the Copper Development Assn, is a two-passenger hatchback weighing 2952 lb, including 1206 lb of batteries. The Transformer I is a four-passenger ''luxury'' car based on the Chevrolet Chevelle, weighing 5850 lb, including 2340 lb of batteries. The smaller car has a maximum speed of 55 mph, acceleration from 0 to 30 mph in 11.8 s; normal charging time is 8 h. Town Car has a maximum range of 120 mi at 40 mph; its stop-and-go range is 75 mi. Eighteen 6-V lead--acid batteries are mounted on a tray which slides in from the rear of the car, occupying the central tunnel. Transformer I, developed by Electric Fuel Propulsion Corp., is powered by an 18-V lead--cobalt battery. It has a range of 70 mi at 40 mph, 50 mi with two stops per mile. Maximum speed is 60 mph; acceleration time from 0 to 30 mph is 12 s. Normal charging time is eight hours with 220 V, although 110 V can be used. The latter would take 48 hours for a full charge. An external fast charger could give the car an 80% charge in 45 to 60 minutes. A 10-minute charge would allow the car to travel 15 mi. A novel ''accessory'' for the larger vehicle is the availability of a mobile gasoline-powered 37.5-kV brushless generating set mounted on an 1860-lb trailer. This setup, although inefficient from an energy standpoint, enables the vehicle to operate where power-line charging facilities are unavailable.

5075 BATTERY CARS TODAY: SOME THEORY AND SOME PRACTICE. Prigmore, B.J. (Imperial Coll. of Science and Tech., London). Electron. Power; 21: No. 11, 671-673(12 Jun 1975).

This article reviews the current position of cars powered by conventional lead--acid batteries.

5076 BATTERIES POWER URBAN AUTOMS. Cairns, E.J.; McBreen, J. (Research Lab., Warren, MI). Ind. Res.; 17: No. 6, 56-60(Jun 1975).

R and D achievements are reviewed, and high temperature cells using lithium are evaluated. Equations, tables, and graphs illustrate data.

5077 ENERGY SOURCES FOR MARINE TECHNOLOGY. Fischer, W. (Brown, Boveri und Cie AG, Heidelberg). VDI (Ver. Dtsch. Ing.) Z.; 117: No. 9, 415-421(May 1975). (In German).

Energy sources for unmanned marine stations and manned underwater stations must satisfy numerous requirements. If one wants to judge which energy source should be used in a definite case of application, then it is necessary to evaluate its properties according to given criteria. Thereby, the mass related to the energy content of an energy source and the costs related to the energy, which come up at the application of an energy supply system, may serve as measures. These costs due to the supply system do not comprise only the prime costs but also a share from the operating costs.

5078 BATTERY CHARGING AND REPLACEMENT STATION FOR MULTICELL ACCUMULATORS OF BATTERY-POWERED VEHICLES. Hagen, H.; Laforce, E. (to Maschinenfabrik Augsburg-Nuernberg (M.A.N.) AG). German(FRG) Patent 2,118,847/C/. 30 Apr 1975. 7p. (In German).

3 figs..

The existing multicell accumulator replacement systems for battery-powered vehicles have the disadvantage that the vehicle must be positioned very accurately between the battery chambers of the replacement station. With non-trackbound vehicles, this is met with considerable difficulties. The present invention claims a charging and replacement station for the multicell accumulators of battery-powered vehicles which allows a fast battery replacement also for non-trackbound vehicles. The multicell accumulators are removed from the vehicle by means of a refuelling cart which can be driven into an opening between two parts of the replacement station designed as battery reception chambers. The technical details of the refuelling cart are described.

5079 MULTICELLED BATTERIES FOR BATTERY-POWERED VEHICLES. Salamon, K. (to Gesellschaft fuer Elektrischen Strassenverker m.b.H.). GE 2,350,353. 24 Apr 1975. Filed date 08 Oct 1973. 11p.

ELECTRIC-POWERED VEHICLES;BATTERY CHARGING; RECOMBINATION;HYDROGEN;OXYGEN;WATER

5080 LUCAS MIDI-BUS TO BE EVALUATED IN MANCHESTER. Energy Dig. (London) ; 4: No. 2, 39(Apr 1975).

A 34-passenger Midi-Bus, fitted with a traction motor, sophisticated control gear, and lightweight lead--acid batteries developed by the Lucas Group, traveled from Birmingham to Manchester. The bus covered the 86 miles from city center to city center via the M6 motorway at an average speed of nearly 30 mph, completing the journey in just over three hours. Total distance covered from depot to depot was 92 miles, and even then the batteries were not fully discharged. The vehicle is powered by a 360-volt dc motor which develops 130 bhp. This is mounted in the center of the chassis, driving the conventional back axle through a propeller shaft, the motor being controlled by a Lucas-designed SCR ''chopper'' controller. The controller operates by connecting and disconnecting the power source to the motor through a solid-state (SCR) switch so rapidly--a few hundred times a second--that the motor sees only the average of the

resultant ''chopped'' voltage. By changing the ratio of the open to closed times of the switch, the average voltage across the motor is varied. Additional solid-state circuitry automatically adjusts the power to the motor so that it is appropriate to the accelerator pedal position set by the driver and the vehicle speed. To extend the operating range of the bus, and minimize wear and tear on the mechanical brakes, a regenerative braking system is fitted. The Lucas vehicle can smoothly accelerate a full complement of passengers from 0 to 30 mph in under 15 seconds, while a top speed of more than 45 mph will ensure that it can quietly hold its own under the worst possible traffic conditions.

5081 FUEL CELLS WITH CARBON ELECTRODES. Radovici, O.; Mavrodin-Tarabic, M.; Onaca, I.; Solacolu, I. (Physical Chemistry Center, Bucharest). Int. Chem. Eng.; 15: No. 1, 108-122(Jan 1975).
Hydrogen--air fuel cells with lead acid batteries. FUEL CELLS;ELECTRODES;REVIEWS;CARBON; ANODES;CATHODES;HYBRID ELECTRIC-POWERED VEHICLES;LEAD-ACID BATTERIES

5082 CHARGE CONTROL SYSTEM FOR BATTERIES CHARGED BY SOLAR CELLS SERIES. Braunstein, A.; Biran, D. (Tel Aviv Univ., Israel). J. Ass. Eng. Archit. Israel; 34: No. 1, 35-9(Jan 1975). (In Hebrew with English abstract).
SOLAR CELL ARRAYS;ELECTRIC BATTERIES; ELECTRIC CHARGES;CONTROL SYSTEMS

5083 HYBRID POWER SOURCE FOR MATERIAL HANDLING EQUIPMENT. O'Sullivan, J.B.; Dowgiallo, E.J.; Snellings, I.R. (Army Mobility Equipment R and D Center, Fort Belvoir, VA). pp 229-236 of Tenth intersociety energy conversion engineering conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1975).
From 10. intersociety energy conversion engineering conference; Newark, Delaware, USA (17 Aug 1975).
See CONF-750812--.
Hydrogen fuel cell--lead-acid battery system for electric fork lift trucks. HYDROGEN FUEL CELLS;LEAD-ACID BATTERIES;HYBRID SYSTEMS; PERFORMANCE TESTING;HYBRID ELECTRIC-POWERED VEHICLES;DESIGN;USES

5084 ECONOMIC STUDY OF ELECTRICAL PEAKING ALTERNATIVES. Parrish, W.R. (National Bureau of Standards, Boulder, CO). pp 949-968 of Hydrogen energy. Part B. Veziroglu, T.N. (ed.). New York; Plenum Publishing Corp. (1975).
From Hydrogen economy Miami energy conference; Miami Beach, Florida, USA (18 Mar 1974).
See CONF-740306--PB.
Results are given of a feasibility study of alternatives for producing peak power. Fuel cells, batteries, and superconducting magnetic storage are considered as well as gas turbines and pumped storage. The fuels considered are hydrogen, from coal or electrolysis, synthetic natural gas, and methanol. Fuel storage alternatives include liquid, compressed gas, and for hydrogen, metallic hydride. (auth)

5085 NICKEL--ZINC STORAGE BATTERIES AS ENERGY SOURCES FOR ELECTRIC VEHICLES. Kucera, G.; Plust, H.G.; Schneider, C. (Dtsch. Automobilges. Forschungslab., Ger.). New York; SAE (1975). 9p.
45 Wh/kg, 2.7-T vans. ELECTRIC-POWERED VEHICLES;NICKEL-ZINC BATTERIES;PLANNING;TRUCKS

5086 PEAKING POWER BATTERIES FOR ELECTRIC UTILITIES. Berkowitz, D.G. (Westinghouse Electric Corp., East Pittsburgh, PA); Brown, J.T. Proc. Am. Power Conf.; 37: 1100-1109(1975).
From Annual American power conference; Chicago, Illinois, USA (21 Apr 1975).
See CONF-750469--.
This paper covers the storage of electrical energy in large-scale electrochemical storage batteries, and the potential effects on electric utility economics and application practices. Significant operating and economic advantages are obtainable through storage. Electric utilities have already experienced such advantages with pumped-storage hydroinstallations. These advantages result simply from shifting the daily peak loads to coal and nuclear base plants during the off-peak hours and, therefore, displacing the need for peak generation that uses higher cost fuels.

5087 STATUS OF ELECTRIC VEHICLE DEVELOPMENT AROUND THE WORLD. Campbell, E.A. (Electric Vehicle Council, New York). Proc. Am. Power Conf.; 37: 1194-1202(1975).
From Annual American power conference; Chicago, Illinois, USA (21 Apr 1975).
See CONF-750469--.
The only energy-storage unit that can at present be used in electrically-driven road vehicles is the lead-acid storage battery, since all other electrochemical storage units are either too costly or have not yet reached an adequate state of development. There is not likely to be a dramatic breakthrough in this area for ten years. Due to the low energy density of lead-acid batteries, vehicles so powered have only a limited range. There are, however, missions which can be accomplished by such vehicles, including buses, multistop short-range urban delivery vans, and small personal cars meeting a majority of commuter and local travel requirements. Hoped-for independence from high-cost, imported petroleum mandates that the development of electric road vehicles and high-energy batteries to power them be pursued vigorously. The development of off-road applications using lead-acid battery power has up to now been considerably more fruitful than on-road applications and can be expected to reach even higher saturation in the years to come. (auth, Summary)

5088 ELECTROCHEMICAL HEAT ENGINES FOR DIRECT ELECTRIC POWER GENERATION AND ENERGY STORAGE. Elliott, G.R.B.; Trela, W.J.; Dials, G.E. New York; American Institute of Aeronautics and Astronautics (1975). 8p.
From 11. propulsion conference; Anaheim, CA, USA (29 Sep 1975).
ELECTROCHEMICAL CELLS;HEAT ENGINES;USES; ELECTRIC POWER;POWER GENERATION;ENERGY STORAGE; STEAM TURBINES;TOPPING CYCLES;PROCESS HEAT;COAL GASIFICATION;DRYING

5089 PLUG FOR DETROIT. THE RESURGENCE OF THE ELECTRIC VEHICLE. Energy Dialog; No. 4, vp(1975).
A dialogue is presented on the status of electric-powered automobiles. Among the topics discussed are: (1) consumer desire for high-powered vehicles; (2) electric batteries as an energy source; and (3) the identification of factions for and against the full-scale development of electric vehicles. Participants in the discussion are the head of the Electric

Vehicle Council, the manager of San Francisco's BART, the research director for General Motors Corp., the originator of Mt. Washington's annual EV race, and a major manufacturer of electric batteries. (PMA)

5090 QUIET, EFFICIENT CONTROLLER FOR ELECTRIC VEHICLES. Armstrong, D.; Pocobello, M. (Triad Serv., Inc). SAE Prepr.; No. 750470, 1-7(1975).
This paper presents an alternative to conventional resistive, SCR, or battery switching controllers for wound-field D.C. motors. A system has been built and tested which keeps battery current (as selected by the driver) constant throughout any maneuver without the problems associated with switching controllers. A system description is included along with test results. Comparisons are made with battery scanning, SCR, and other control types which show this system of combined field control, voltage switching, and armature current control to be more efficient.

5091 BATTERIES FOR MAIL VANS. Christianson, C.C. (Gould Corp., St. Paul). pp 46-48, 52-53 of Battery Council International convention: 1975. Chicago; Battery Council International (1975).
From 87. Battery Council International convention; Hollywood, Florida, USA (8 Apr 1975).
See CONF-7504129--.
An electric vehicle designed for the U.S. Postal Service is described. The propulsion system components of the postal van are discussed in some detail. The battery is a 27-cell, 54-V battery weighing about 1300 pounds and delivering 330 Ah. A dc to dc converter converts 54 V to 12 V for accessories. Regenerative braking is utilized when stopping from more than 15 mph. Charging and performance data are summarized. (RWR) 5 figures.

5092 ELECTRIC MAIL DELIVERY VANS. Crane, D.P. (Office of Fleet Management, Washington, DC). pp 27-33 of Battery Council International convention: 1975. Chicago; Battery Council International (1975).
From 87. Battery Council International convention; Hollywood, Florida, USA (8 Apr 1975).
See CONF-7504129--.
The scope of vehicle management in the U.S. Postal Service is explained, and a brief history of past involvement with electric vehicles is given. Recent performance experience with electrics is reviewed. A number of photographs show a new electric jeep and its battery-related components. 12 figures. (RWR)

5093 TIME FOR REALITY. Bry, R. (Otis Elevator Co., Cleveland). pp 41-44 of Battery Council International convention: 1975. Chicago; Battery Council International (1975).
From 87. Battery Council International convention; Hollywood, Florida, USA (8 Apr 1975).
See CONF-7504129--.
A brief summary of the social, technical, and economic status of electric-powered vehicles is presented. Although several experimental buses are currently in use, the cost of electric batteries remains an unpopular feature, and development of a suitable battery continues to be the chief R and D problem. However, electrical energy can be derived from a variety of sources, and, although electricity costs may continue to rise, they will rise at a slower rate than petroleum costs. (PMA)

5094 BATTERY POWERED MAIL VANS. Johnson, R.M. pp 45-46, 49-52 of Battery Council International convention: 1975. Chicago; Battery Council International (1975).
From 87. Battery Council International convention; Hollywood, Florida, USA (8 Apr 1975).
See CONF-7504129--.
An electric vehicle designed for the U.S. Postal Service is described. 14 figures. (RWR)

5095 RESEARCH AND DEVELOPMENT IN THE FIELD OF BATTERIES. Cook, A.R. Mater. Tech.; 62: No. 11, 459-465(Nov 1974). (In French).
The currently available electric batteries for propulsion of vehicles are critically examined, and some new types of future batteries suitable for this purpose are discussed. The features of future electric vehicles are outlined.

5096 MUCH DISCUSSED ELECTRIC VEHICLE: WILL IT BECOME A REALITY. Gallot, J. Mater. Tech.; 62: No. 11, 467-472(Nov 1974). (In French).
The current status of development of electric vehicles, particularly automobiles, is discussed with emphasis on electric batteries, the means of their recharging and replacement, the vehicle engine, and the vehicle design. The advantages of electric vehicles are pointed out, and future prospects in this field are outlined.

5097 POTENTIAL NEW POWER SYSTEMS FOR CITY TRANSPORTATION. Sale, B.; Breelle, Y. (Inst. Fr. de Pet). Rev. Inst. Fr. Pet. Ann. Combust. Liquides; 29: No. 6, 901-915(Nov-Dec 1974). (In French).
Various energy sources to replace the internal combustion engine are surveyed, and possibilities of pollution and noise reduction discussed. Thermal engines and battery-powered vehicles could be the answer.

5098 SUPPLY OF ENERGY FOR EVS AND ITS INCORPORATION INTO THE LOAD CURVES OF ELECTRIC UTILITIES. Oehms, K.J. (Rheinisch-Westfalisches Elektrizitatswerk AG, Essen); Busch, H. Electr. Veh. News; 29-31(Nov 1974).
A brief discussion is given of the impact of general electric-powered vehicle use on public utilities. Slow battery charging, which increases battery service life, can be carried out during off-peak periods. (PMA)

5099 EV DESIGN ENGINEERS IN, STYLISTS OUT. Dann, R.T. Mach. Des.; 46: No. 25, 120-128(17 Oct 1974).
ELECTRIC-POWERED VEHICLES;COST;REVIEWS; AERODYNAMICS;BRAKES;ELECTRIC BATTERIES;DESIGN; PACKAGING

5100 EV MOTORS: DC NOW, AC LATER. Leonard, M. Mach. Des.; 46: No. 25, 129-134(17 Oct 1974).
ELECTRIC-POWERED VEHICLES;ELECTRIC MOTORS; DIRECT CURRENT;ALTERNATING CURRENT;TORQUE; BRAKES;ELECTRIC BATTERIES;BATTERY CHARGING; COOLING

5101 PEAK LOAD LEVELLING SYSTEM. Frank, K.; Thorborg, K. (to Allmanna Svenska Elektriska Aktiebolaget). US Patent 3,932,799. 16 Oct 1974. Priority date 23 Oct 1973, Sweden. vp.
A load-leveling system for connection to an

alternating current network is described. The system comprises an electrochemical direct current energy supply, a line-commutated controllable electronic power convertor having dc terminals connected to the energy supply and ac terminals for connection to the ac network, and continuously controllable reactive power generating means connected to the ac terminals. The reactive power generating means comprise a fixed capacitor battery and a line-commutated reactive power convertor. The convertor comprises two line-commutated thyristor convertor connections, each connection having dc and ac terminals. The convertor connections are series connected through their dc terminals and have transformer means connecting their ac terminals. The first convertor connection has a higher rated voltage than the second. Means for setting the control angle of the first convertor connection to either one of two substantially fixed values, corresponding to full direct voltage in rectifying and in inverting operation and means for controlling the second convertor connection with a variable control angle are also included.

5102 IRON--AIR BATTERY BUS COULD GO FURTHER. Electr. Rev. (London); 185: No. 13, 440(11 Oct 1974).
Iron-air battery systems with outputs of ''several hundred kW'' could be engineered immediately, states a report prepared for the Government Transport and Road Research Laboratory as a result of a 12 month study by the Electrical Research Association and City University's Electrochemical Technology Unit. (Fuel Abstr)

5103 NEW ASSAULT ON BATTERY VEHICLES. Electr. Rev. (London); 195: No. 12, 412-413(4 Oct 1974).
Discusses whether any of the newer and potentially more powerful systems, such as fuel cells, metal-air, nickel-zinc or sodium sulfur, will replace the tried and trusted, but weighty, lead-acid battery in commercial service. (Fuel Abstr.)

5104 SYNTHETIC FUELS: WHERE WE STAND TODAY. Automot. Eng. (N.Y.); 82: No. 10, 38-43(Oct 1974).
VEHICLES;ELECTRIC-POWERED VEHICLES;ELECTRIC BATTERIES;SYNTHETIC FUELS;HYDROCARBONS;ALCOHOLS; AMMONIA;HYDROGEN;AUTOMOTIVE FUELS

5105 ABC'S OF SMALL ELECTRIC VEHICLES. Automot. Eng. (N.Y.); 82: No. 9, 58-69(Sep 1974).
ELECTRIC-POWERED VEHICLES;ELECTRIC BATTERIES; AUTOMOBILES;SHIPS;ELECTRIC MOTORS;PERFORMANCE; BATTERY CHARGING

5106 PARALLEL-CONNECTED MOTOR DRIVE FOR BATTERY POWERED VEHICLES. Lamb, C.St.J. (New South Wales Inst. Technol., Broadway, Australia). Electr. Rev. (London); 195: No. 1, 11-13(5 Jul 1974).
ELECTRIC-POWERED VEHICLES;ELECTRIC MOTORS; DESIGN;AUTOMOBILES

5107 (EPA--460/3-74-013-a(Vol.1)) CURRENT STATUS OF ALTERNATIVE AUTOMOTIVE POWER SYSTEMS AND FUELS. VOLUME I. EXECUTIVE SUMMARY. Lapedes, D.E.; Hinton, M.G.; Meltzer, J.; Iura, T. (Aerospace Corp., El Segundo, Calif. (USA)). Jul 1974. Contract 68-01-0417. 51p. Dep. NTIS $5.75.
AUTOMOBILES;ENGINES;PROPULSION;RANKINE CYCLE ENGINES;STIRLING ENGINES;DIESEL ENGINES;WANKEL ENGINES;STRATIFIED CHARGE ENGINES;ELECTRIC-POWERED VEHICLES;HYBRID ELECTRIC-POWERED VEHICLES;ELECTRIC BATTERIES;FLYWHEELS; AUTOMOTIVE FUELS;COMPARATIVE EVALUATIONS; GASOLINE;MIXTURES;NATURAL GAS;SYNTHETIC FUELS; HYDROGEN FUELS;SYNTHETIC PETROLEUM;METHANOL; METHANE;PROPANE;ETHANOL;AMMONIA;HYDRAZINE

5108 (EPA--460/3-74-013-d(Vol.4)) CURRENT STATUS OF ALTERNATIVE AUTOMOTIVE POWER SYSTEMS AND FUELS. VOLUME IV. ELECTRIC AND HYBRID POWER SYSTEMS. Lapedes, D.E.; Hinton, M.G.; Meltzer, J.; Iura, T.; Dykema, O.; Forrest, L.; Hagen, K.; Kettler, J.; LaFrance, R.; Smalley, W. (Aerospace Corp., El Segundo, Calif. (USA)). Jul 1974. Contract 68-01-0417. 260p. Dep. NTIS $16.00.
ELECTRIC-POWERED VEHICLES;HYBRID ELECTRIC-POWERED VEHICLES;AUTOMOBILES;HEAT ENGINES; HYBRID SYSTEMS;FLYWHEELS;ELECTRIC BATTERIES; DESIGN;PERFORMANCE;FORECASTING;ENERGY STORAGE; LEAD-ACID BATTERIES;NICKEL-ZINC BATTERIES; NICKEL-HYDROGEN BATTERIES;USES

5109 ACCUMULATORS FOR ELECTRIC ROAD VEHICLES. Fischer, W. (BBC, AG, Heidelburg, Germany). Elektrizitaetsverwertung; 49: No. 7-8, 296-303(Jul-Aug 1974).
ELECTRIC-POWERED VEHICLES;LEAD-ACID BATTERIES;ELECTRIC BATTERIES;AUTOMOBILES;ENERGY; PLANNING

5110 SYSTEMATIC BATTERY CONCEPTION FOR ELECTRIC VEHICLES. D'Arey, R.L. (Varta Batteries AG, Hannover, Germany). Elektrizitaetsverwertung; 49: No. 7-8, 312-15(Jul-Aug 1974).
ELECTRIC-POWERED VEHICLES;ELECTRIC BATTERIES; MARKET;ECONOMICS;PLANNING;USES

5111 FOCUS ON STANDBY SUPPLIES. Electr. Times; No. 4287, 11(27 Jun 1974).
Standby plant makers foresee technical advance across a broad front. Static switching and sealed, maintenance-free cells are promoting battery acceptability; better power/weight ratios and new thinking in control will advance engined units. Technical implications are considered. (Fuel Abstr.)

5112 NO ASSAULT ON LEAD--ACID BATTERY UNTIL 1980. Electr. Rev. (London); 194: No. 22, 696(14 Jun 1974).
The Chloride Co views are given on time-scale card areas of breakthrough for introduction of lead--acid batteries for vehicles and ''exotic'' batteries.

5113 HOW FORD EVALUATES THREE TYPES OF ELECTRIC VEHICLES. Automot. Eng. (N.Y.); 82: No. 6, 37-41, 75, 77(Jun 1974).
ELECTRIC-POWERED VEHICLES;AUTOMOBILES; ELECTRIC BATTERIES;PERFORMANCE TESTING;RANGE; VELOCITY;COST;ACCELERATION

5114 LITHIUM POWER MAY PUT ELECTRIC CAR IN YOUR FUTURE. Iron Age; 213: No. 19, 64-6(13 May 1974).
3000-lb vehicle, 60 to 70 mph, lifetime of 3 to 5 years. AUTOMOBILES;ELECTRIC-POWERED VEHICLES;LITHIUM-SULFUR BATTERIES;OFF-PEAK ENERGY STORAGE;PERFORMANCE

5115 WHAT'S AVAILABLE. Cusano, A.J. (Dual-Lite Co., Newton, CT). Light. Des. Appl.; 4:

No. 5, 6-8(May 1974).
The trend is away from the tackle-box look. Battery-operated systems, particularly inverter units, offer the installation owner new options. A typical emergency system consists of a fully automatic, solid-state charger, lead or nickel--cadmium battery, a dc-to-ac static inverter, and a transfer relay. The standard equipment normally powered by utility output immediately switches over to the emergency ac system when normal ac power fails.

5116 PACKING, SORTING, AND PREPARING FOR SHIPMENT BY MEANS OF CONTINUOUS CONVEYORS. Salzer, J. (Salzer, Offenbach, Ger.). Foerdern Heben; 24: No. 7, 676-680(May 1974). (In German).
Based on the consideration that should lead to a development of the right concept of material flow, this paper discusses guidelines for planned materials-flow systems. As a case-in-point, planning and operation of a central warehouse in a plant manufacturing automobile parts and accessories are described. The system uses conveyors (horizontal and vertical), automatic paletting, and storage battery vehicles.

5117 ANOTHER CHANCE FOR ELECTRICS. Gottesman, C.A.; Pond, J.B. Automot. Ind.; 150: No. 8, 29-34(15 Apr 1974).
AUTOMOBILES;ELECTRIC-POWERED VEHICLES;NICKEL-ZINC BATTERIES;IRON-NICKEL BATTERIES;ZINC-CHLORINE BATTERIES;BATTERY CHARGING;SOLAR ENERGY CONVERSION;THERMAL INSULATION;HEAT RECOVERY;DESIGN;SOLAR ENERGY;USES

5118 BOSCH INVESTIGATES HYBRIDS. Fersen, O.G.W. Automot. Ind.; 150: No. 8, 43-5(15 Apr 1974).
HYBRID ELECTRIC-POWERED VEHICLES;DESIGN; ELECTRIC BATTERIES;AUTOMOBILES;PERFORMANCE

5119 ROLE OF BATTERY RELATED SYSTEMS IN OFFSHORE ENGINEERING. Edge, R.J.D. Pet. Rev.; 28: No. 327, 169-173(Mar 1974).
OFFSHORE SITES;ELECTRIC BATTERIES;PETROLEUM; PETROCHEMICALS;STORED ENERGY;ENERGY STORAGE; NATURAL GAS;CHEMICAL REACTIONS;EXPLORATION; PRODUCTION;TRANSPORT;NORTH SEA

5120 CHLORIDE UNVEILS THE ''SILENT RIDER''. Elec. Veh.; 60: No. 1, 4-7(Mar 1974).
Battery-powered 50-passenger city bus. ELECTRIC-POWERED VEHICLES;LEAD-ACID BATTERIES; USES;OPERATION;BATTERY CHARGERS;PERFORMANCE

5121 MEETING FUTURE PEAK ELECTRICAL ENERGY DEMANDS BY MEANS OF ELECTROCHEMICAL STORAGE SYSTEMS. Beccu, K.D. (Battelle Forschungszent., Geneva, Switzerland). Chem.-Ing.-Tech.; 46: No. 3, 95-9(Feb 1974). (In German).
OFF-PEAK ENERGY STORAGE;ELECTRIC BATTERIES; PERFORMANCE;COMPARATIVE EVALUATIONS;ECONOMICS; HIGH TEMPERATURE;REDOX FUEL CELLS

5122 MAGNETIC CONTROL THYRISTOR CHOPPER EQUIPMENT FOR BATTERY VEHICLE. Ibamoto, M.; Kiwaki, H.; Toyama, J.; Takei, K. (Hitachi, Ltd., Ibarski, Japan). IEEE Trans. Veh. Technol.; VT-23: No. 1, 19-22(Feb 1974).
ELECTRIC-POWERED VEHICLES;ELECTRIC BATTERIES; THYRISTORS;CONTROL SYSTEMS

5123 ELECTROCHEMICAL CAR PROPULSION HAS ARRIVED. Brun, J.; Tunold, R. (Nth, Trondheim, Norway). Tek. Ukebl.; 121: No. 4, 12-19(24 Jan 1974). (In Norwegian).
ELECTRIC-POWERED VEHICLES;FUEL CELLS; ELECTRIC BATTERIES;LEAD-ACID BATTERIES;METAL-GAS BATTERIES;SODIUM-SULFUR BATTERIES; SPECIFICATIONS;USES

5124 SOME STUDIES RELATED TO ELECTRICITY GENERATION FROM BIOLOGICAL FUEL CELLS AND GALVANIC CELLS, IN VITRO AND IN VIVO. Wan, Y.C.; Tseung, A.C.C. (R. Coll. of Surg. of Engl., London). Med. Biol. Eng.; 12: No. 1, 14-28(Jan 1974).
BIOCHEMICAL FUEL CELLS;GLUCOSE;CARDIAC PACEMAKERS;IN VIVO;ELECTRODES;PLATINUM;ELECTRIC BATTERIES;OPERATION

5125 ANALOG COMPUTER STUDY OF THE PROCESSES IN THE DRIVE OF A STORAGE BATTERY MINE CAR USING PULSE CONTROL OF THE MOTORS. Lyubimov, E.V.; Sapunkov, M.L. (Per'm Polytech. Inst., USSR). Elektrichestvo; No. 1, 46-50(Jan 1974). (In Russian).
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5126 AUTOMOTIVE POWER PLANTS. LONG-TERM OUTLOOK. Wilson, W.E. Eng., Cornell Q.; 8: No. 4, 39-44(Win 1974).
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A present and future technology assessment is given of electric cars, covering energy storage (electric batteries and fuel cells), electric motors, control systems, battery charging, and hybrid systems. The following conclusions are drawn: (1) only electric cars really offer hope as a satisfactory long-term solution in technical, economic and health terms; (2) a great deal of development is required before electric cars can achieve technical and economic acceptability; and (3) the rate of development could be accelerated partly by legislation and partly by increasing research and development funds, particularly into the development of electrochemical cells, both storage batteries and fuel cells.

5153 ELECTRIC CARS: ENERGY STORAGE AND CONVERSION. Dunn, P.D. (Univ. of Reading, Eng.). pp 128-141 of Vehicle engines fuel consumption and air pollution. Volume 3. Janota, M.S. (ed.). Stevenage, Eng.; Peter Peregrinus Ltd. (1974).
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The current position and future possible development of electrochemical converters for electric-powered vehicles are considered. Topics discussed include primary energy sources, energy storage, electrochemical conversion, electric batteries, and fuel cells. Factors considered for electrochemical convertors are size, cost, safety, cycle life, recharging time, range, and performance. (PMA)

5154 CRITICAL CONSIDERATIONS OF INTEGRATING ELECTRICITY DRIVEN COMMERCIAL VEHICLES WITH CITY TRAFFIC. Albrecht, H.; von Scarpatetti, D. (Daimler-Benz, Stuttgart). Elektrotech. Z., A; 94: No. 11, 661-665(Nov 1973). (In German).
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5155 ELECTRIC PROPULSION FOR ROAD VEHICLES, STATE OF THE ART AND PRESENT PROBLEMS. Bader, C.; Plust, H.G. (Dtsch Automobilges, Hanover). Elektrotech. Z., A; 94: No. 11, 637-645(Nov 1973). (In German).
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5184 DUAL TURBINE--BATTERY ELECTRIC VEHICLE DRIVE SYSTEM. Heise, C.J. (US Army Mobility Equipment Research and Development Center, Electrical Equipment Div., Fort Belvoir, VA). pp 1103-10 of Proceedings of 7th Intersociety Energy Conversion Engineering Conference, Hilton Inn, San Diego, California, September 25-29, 1972. Washington, DC; American Chemical Society (1972).
From 7. intersociety energy conversion engineering conference; San Diego, California, USA (25 Sep 1972).
HYBRID ELECTRIC-POWERED VEHICLES;DESIGN; OPERATION;TESTING;NICKEL-CADMIUM BATTERIES; POWER CONDITIONING CIRCUITS;PERFORMANCE;USES

5185 FUEL-CELL/LEAD--ACID-BATTERY HYBRID CAR. Andrew, M.R.; Gressler, W.J.; Johnson, J.K.; Short, R.T.; Williams, K.R. New York; SAE (1972). 7p.
HYDRAZINE FUEL CELLS;AIR;LEAD-ACID BATTERIES; ELECTRIC-POWERED VEHICLES;PERFORMANCE;USES

5186 ELECTROCHEMICAL POWER SOURCES FOR VEHICLE PROPULSION. Hietbrink, E.H.; McBreen, J.; Selis, S.M.; Tricklebank, S.B.; Witherspoon, R.R. pp 47-97(Chap. 3) of Electrochemistry of cleaner environments. Bockris, J.O'M. (ed.). New York; Plenum Press (1972).
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5187 ELECTROCHEMICAL POWER SOURCES FOR VEHICLE PROPULSION. Hietbrink, E.H.; McBreen, J.; Selis, S.M.; Tricklebank, S.B.; Witherspoon, R.R. (Res. Lab., Gen. Mot. Corp., Warren, MI). pp 47-97 of Electrochem. Cleaner Environ. Bockris, J.O'M. (ed.). New York; Plenum Press (1972).
Pb--acid, Ni--Cd, Ag--Zn, Ni--Zn, Zn--$MnO_2$, metal--air, org. electrolyte batteries and fuel cells. ELECTRIC-POWERED VEHICLES;ELECTRIC BATTERIES;COMPARATIVE EVALUATIONS;LEAD-ACID BATTERIES;NICKEL-CADMIUM BATTERIES;SILVER-ZINC BATTERIES;NICKEL-ZINC BATTERIES;ZINC-MANGANESE BATTERIES;METAL-GAS BATTERIES;FUEL CELLS; REVIEWS;PERFORMANCE;VELOCITY;RANGE;ACCELERATION

5188 (AD--786813) DEVELOPMENT OF A COMBINATION POWER INSTALLATION AND ELECTRIC DRIVE SYSTEM FOR A CITY BUS. Zorokhovich, A.E.; Gushcho-Malkov, B.P.; Levental, L.Ya.; Khomenko, A.I.; Gorodetskii, E.M. Translated from Tr. Mosk. Inst. Inzh. Zheleznodorozhn. Transp.; No. 401, 114-124(1972). 13p. NTIS $3.25.
BUSES;HYBRID ELECTRIC-POWERED VEHICLES; HYBRID SYSTEMS;URBAN AREAS;DIESEL ENGINES; ELECTRIC BATTERIES;ELECTRIC MOTORS;ELECTRIC GENERATORS;PERFORMANCE TESTING

5189 AUXILIARY SERVICES FOR A FUEL-CELL HYBRID ELECTRIC CAR. Andrew, M.R.; Gressler, W.J.; Johnson, J.K.; Short, R.T.; Williams, K.R. New York; SAE (1972). 14p.
From SAE meeting; (10-14 Jan 1972).
HYBRID ELECTRIC-POWERED VEHICLES;LEAD-ACID BATTERIES;PUMPS;CONTROL SYSTEMS;BLOWERS;DESIGN; FUEL CELLS

5190 RECENT DEVELOPMENTS IN BATTERIES AND VOLTAIC CELLS. Barak, M. Electron. Power; 18: 290-6(1972).
ELECTRIC-POWERED VEHICLES;ELECTRIC BATTERIES; AIR;METAL-GAS BATTERIES;ELECTRONIC CIRCUITS; PERFORMANCE

5191 NEREM 72 RECORD, PART 1: TECHNICAL PAPERS. Marino, J.J.; Sarkisian, E.A.; Madigan, R.J.; Silien, J.S.; Hinman, E.J.; Raposa, F.L.; Kusko, A.; Hopkins, J.B.; Saxton, L.; Thornton, R.D.; Rigsby, M.A.; White, K.E.; Sununu, J.H. New York; IEEE (1972). 319p.
From IEEE northeast electron research and engineering meeting; Boston, MA (30 Oct-3 Nov 1972).
MEETINGS;ELECTRIC-POWERED VEHICLES;HYBRID ELECTRIC-POWERED VEHICLES;DESIGN;TRANSPORTATION SYSTEMS

5192 PROCEEDINGS OF THE SYMPOSIUM ON BATTERIES FOR TRACTION AND PROPULSION, COLUMBUS, OHIO, 7-8 MAR 1972. Kerry, R.L.; McCallum, J.; Semones, D.E. (US Air Force, Aero Propulsion Lab., Dayton, OH). Columbus, OH; Electrochemical Society (1972). 333p.
From Symposium on batteries for traction and propulsion; Columbus, OH (7-8 Mar 1972).
ELECTRIC-POWERED VEHICLES;MEETINGS;OHIO;LEAD-ACID BATTERIES;PERFORMANCE;ZINC-AIR BATTERIES; HYBRID ELECTRIC-POWERED VEHICLES;LEADING ABSTRACT;ELECTRIC BATTERIES;FUEL CELLS

5193 BATTERIES FOR GROUND TRANSPORTATION SYSTEMS. Salomon, M. (US Dept. of Transportation, Cambridge, MA). pp 26-41 of Proceedings of the symposium on batteries for traction and propulsion, Columbus, Ohio, 7-8 Mar 1972. Columbus, OH; Electrochemical Society (1972).
From Symposium on batteries for traction and propulsion; Columbus, OH (7-8 Mar 1972).
LEAD-ACID BATTERIES;NICKEL-ZINC BATTERIES; FUEL CELLS;ORGANIC COMPOUNDS;ELECTROLYTES;HIGH TEMPERATURE;USES;ELECTRIC-POWERED VEHICLES

5194 USAMERDC BATTERY PROGRAM: CONCEPTS AND CAPABILITIES FOR ELECTRIC PROPULSION. Huff, J.R.; O'Sullivan, J.B.; Dowgiallo, E.; Snellings, I.R.; Anderson, R. (US Army Mobility Equipment Res. and Dev. Cent., Fort Belvoir, VA). pp 42-64 of Proceedings of the symposium on batteries for traction and propulsion, Columbus, Ohio, 7-8 Mar 1972. Columbus, OH; Electrochemical Society (1972).
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5195 DATA AND PERFORMANCE REQUIRED OF THE LEAD ACID BATTERY BY THE ELECTRIC VEHICLE DESIGNER. Cook, A.R. (Int. Lead Zinc Res. Organization, Inc., New York, NY). pp 65-101 of Proceedings of the symposium on batteries for traction and propulsion, Columbus, Ohio, 7-8 Mar 1972. Columbus, OH; Electrochemical Society (1972).
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5196 CONSTRUCTION AND PERFORMANCE OF A QUASI-BIPOLAR LEAD--ACID BATTERY PLATE FOR ELECTRIC PROPULSION. Taylor, A.H.; Giner, J.; Goebel, F. (Tyco Lab., Inc., Waltham, MA). pp 102-34 of Proceedings of the symposium on batteries for traction and propulsion, Columbus, Ohio, 7-8 Mar 1972. Columbus, OH; Electrochemical Society (1972).
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9.7 Wh/lb at 100 W/lb. FABRICATION; PERFORMANCE;LEAD-ACID BATTERIES;PLATES;HYBRID ELECTRIC-POWERED VEHICLES;HEAT ENGINES

5197 ZINC--AIR BATTERIES FOR TRACTION AND PROPULSION. Lenfant, P. (Hydro-Quebec Inst. of Res., Varennes). pp 164-77 of Proceedings of the symposium on batteries for traction and propulsion, Columbus, Ohio, 7-8 Mar 1972. Columbus, OH; Electrochemical Society (1972).
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5198 APPLICATION OF SOLID ELECTROLYTE BATTERIES TO AUTOMOTIVE PROPULSION. Gelb, G.H.; Richardson, N.A.; Seo, E.T.; Silverman, H.P. (TRW Systems Group, Redondo Beach, CA). pp 178-94 of Proceedings of the symposium on batteries for traction and propulsion, Columbus, Ohio, 7-8 Mar 1972. Columbus, OH; Electrochemical Society (1972).
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5199 CURRENT DEVELOPMENTS IN THE SODIUM SULFUR BATTERY. Busi, J.D. (US Army Foreign Science and Technol. Center, Washington, DC). pp 195-208 of Proceedings of the symposium on batteries for traction and propulsion, Columbus, Ohio, 7-8 Mar 1972. Columbus, OH; Electrochemical Society (1972).
From Symposium on batteries for traction and propulsion; Columbus, OH (7-8 Mar 1972).
Zinc--air traction batteries for light-weight vehicles. SODIUM-SULFUR BATTERIES;ZINC-AIR BATTERIES;ELECTRIC-POWERED VEHICLES; PERFORMANCE;USES

5200 BATTERIES FOR THE HYBRID HEAT ENGINE/ ELECTRIC VEHICLE. Kettler, J.R. (Aerospace Corp., El Segundo, CA). pp 213-41 of Proceedings of the symposium on batteries for traction and propulsion, Columbus, Ohio, 7-8 Mar 1972. Columbus, OH; Electrochemical Society (1972).
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HYBRID ELECTRIC-POWERED VEHICLES;HEAT ENGINES;SPECIFICATIONS;NICKEL-CADMIUM BATTERIES; NICKEL-ZINC BATTERIES;LEAD-ACID BATTERIES; PLANNING

5201 PERFORMANCE CAPABILITIES OF ELECTRIC HIGHWAY VEHICLES UTILIZING LEAD ACID BATTERIES. Goldman, W.E. (Anderson Power Products Inc., Brighton, MA). pp 242-54 of Proceedings of the symposium on batteries for traction and propulsion, Columbus, Ohio, 7-8 Mar 1972. Columbus, OH; Electrochemical Society (1972).
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PERFORMANCE;ELECTRIC-POWERED VEHICLES;LEAD-ACID BATTERIES;RANGE

5202 ELECTRIC TRANSIT BUS BATTERY REQUIREMENTS. Borisoff, B. (Tork-Link Corp., Studio City, CA). pp 255-70 of Proceedings of the symposium on batteries for traction and propulsion, Columbus, Ohio, 7-8 Mar 1972. Columbus, OH; Electrochemical Society (1972).
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ELECTRIC-POWERED VEHICLES;ELECTRIC BATTERIES; COST;PERFORMANCE;ECONOMICS

5203 CAPABILITIES OF THE ELECTRIC BATTERY-POWERED MULTI-STOP DELIVERY VEHICLES TODAY AND IN THE FUTURE. Hafer, P.R. (Battronic Truck Corp.). pp 271-85 of Proceedings of the symposium on batteries for traction and propulsion, Columbus, Ohio, 7-8 Mar 1972. Columbus, OH; Electrochemical Society (1972).
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ELECTRIC-POWERED VEHICLES;DESIGN;PERFORMANCE; COST;ELECTRIC BATTERIES

5204 LUNAR ROVER BATTERY AND HIGH ENERGY DENSITY COUPLES FOR PROPULSION. Broglio, E.P. (Eagle-Picher Industries, Inc., Joplin, MO). pp 286-94 of Proceedings of the symposium on batteries for traction and propulsion, Columbus, Ohio, 7-8 Mar 1972. Columbus, OH; Electrochemical Society (1972).
From Symposium on batteries for traction and propulsion; Columbus, OH (7-8 Mar 1972).
$Zn/O_2$. ZINC-AIR BATTERIES;OPERATION;ELECTRIC-POWERED VEHICLES;APOLLO PROJECT

5205 HIGH-RATE LEAD--ACID BATTERIES FOR HYBRID VEHICLES. Biddick, R.E.; Mueller, G.A.; Sayano, R.R.; Silverman, H.P. (Gould Inc., St. Paul, MN). pp 295-306 of Proceedings of the symposium on batteries for traction and propulsion, Columbus, Ohio, 7-8 Mar 1972. Columbus, OH; Electrochemical Society (1972).
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LEAD-ACID BATTERIES;HYBRID ELECTRIC-POWERED VEHICLES;HEAT ENGINES;OPERATION;ENERGY LOSSES; ELECTRIC CONDUCTIVITY;CHEMICAL ACTIVATION; POLARIZATION;QUANTITY RATIO;GASES;EMISSION; ELECTROLYTES;GRIDS;CONNECTORS;WEIGHT; PERFORMANCE

5206 REQUIREMENTS OF AN ELECTROCHEMICAL POWER SOURCE FOR A DUAL-MODE URBAN TRANSPORTATION SYSTEM. Beck, T.R. (Boeing Scientific Research Labs., Seattle). pp 379-383 of From electrocatalysis to fuel cells. Sandstede, G. (ed.). Seattle; University of Washington Press (1972).
A great deal of discussion has been carried on about replacing the internal combustion engine in automobiles by batteries or fuel cells, and there are certainly some promising electrochemical systems under development. A possible alternative to the present automobile, less demanding on an electrochemical power source is described. This is a dual-mode system utilizing a small vehicle operated on a secondary electrochemical power source on city streets and on electric power supplied through a trolley while on an electrified rail system. Power and energy requirements for the dual-mode vehicle are within the present state of the art of lead-acid batteries, although a higher energy density electrochemical system would be desirable.

5207 ELECTROCHEMICAL SOURCES OF CURRENT TODAY. Schmidt, H.; Vielstich, W. (Univ., Bonn). Chem. Unserer Zeit; 6: No. 4, 101-111(1972). (In German).
ELECTRIC BATTERIES;PRIMARY BATTERIES;FUEL CELLS;HYBRID SYSTEMS;USES;ECONOMICS;PERFORMANCE; SERVICE LIFE;REVIEWS;ELECTROCHEMICAL CELLS

5208 ALTERNATIVES TO THE INTERNAL COMBUSTION ENGINE: IMPACTS ON ENVIRONMENTAL QUALITY.

Ayres, R.U.; McKenna, R.P. Baltimore; Johns Hopkins University Press (1972). 337p. $12.00.

A comprehensive analysis is given of existing and potential power plants for automotive vehicles. While technological and economic features of these devices are treated in detail, the whole discussion revolves around the environmental effects of the alternatives considered. The text gathers together in one place what is known about the technology and economics of reducing automobile emissions, as well as presenting some original analyses. It should help the reader assess what is technologically feasible, and provide a basis for consideration of policies for reducing automotive externalities. Some parts of the book are moderately technical, but a special effort is made to present material clearly. Some knowledge of basic physics and chemistry plus a feeling for how mechanical things work should carry the reader comfortably through the bulk of the book. In Part I (chapters 1 and 2) the authors establish the context of the study and describe the internal combustion engine as a source of environmental problems. In Part II they examine energy conversion and energy storage and analyze the various technological options, including further modification of the internal combustion engine. These subjects, which are examined in considerable detail in chapters 3-12, are summarized in chapter 13 (primarily for readers who are not interested in so much detail), and the various options are compared in terms of performance and cost in chapter 14. In Part III (chapter 15) the authors conclude their study with a brief comment on some policy aspects of controlling automotive externalities.

5209 STATE OF DEVELOPMENT OF THE ELECTRIC STREET VEHICLE AND ITS FUTURE TRENDS. Oehms, K.J. (RWE-Hauptverwaltung, Essen). Elektrizitaetswirtschaft; 70: No. 17, 511-517(16 Aug 1971). (In German).

The important electric drive components for the electric road vehicle, the dc motor, thyristor control, the lead--acid accumulator and battery-changing technique are found to be satisfactory in test vehicles for use in West German towns. The impact of the electrically driven vehicles on air pollution is discussed.

5210 CITY CAR WITH H--AIR FUEL CELL/LEAD BATTERY (ONE YEAR OPERATING EXPERIENCES). Kordesch, K.V. (Union Carbide Corp., Cleveland, OH). 6th Intersociety Energy Conversion Engineering Conference Proceedings, SAE Paper 719015. New York; Soc. Auto. Engrs. (Aug 1971).

See PB--230845.

33 kWh fuel cell battery and 25 kW peak power lead battery. ELECTRIC-POWERED VEHICLES; HYDROGEN FUEL CELLS;AIR;PERFORMANCE;MAINTENANCE; COST;RELIABILITY;LEAD-ACID BATTERIES

5211 TRACTION BATTERIES. Wagle, S.S. Indian East. Eng.; 113: No. 8, 379-83(Aug 1971).

ELECTRIC-POWERED VEHICLES;LEAD-ACID BATTERIES;FUEL CELLS;ELECTRIC BATTERIES;DESIGN

5212 CLEAN AIR CAR RACE. THE WORCESTER GREMLIN KVA-SST. Beardsley, C.W. IEEE Trans. Veh. Technol.; VT-20: No. 2, 18-23(May 1971).

On August 24, 1970, 42 low-emission vehicles left Massachusetts Institute of Technology on the first leg of the Clean Air Race. In the electric-hybrid category, the Worcester Polytechnic Institute entry used an internal-combustion engine running on unleaded gas in combination with a battery-powered drive system. In city driving, it uses batteries to drive its electric motor. In the country, an internal-combustion engine running on unleaded gas drives an alternator to provide power to drive the motor as well as to recharge the batteries.

5213 DEVELOPMENT OF THE ELECTRIC ROAD VEHICLE. Ulvonas, S. Tek. Tidskr.; 101: No. 3, 16-18(18 Feb 1971). (In Swedish).

ELECTRIC-POWERED VEHICLES;LEAD-ACID BATTERIES;FUEL CELLS;ECONOMICS;ENERGY STORAGE; USES

5214 COMPARATIVE EVALUATION OF POWER-SYSTEM TYPES OF UNDERSEAS APPLICATIONS. Wimmer R.E. Isot. Radiat. Technol.; 9: No. 2, 235-7(Win 1971).

UNDERWATER;ELECTRIC BATTERIES;FUEL CELLS; RADIOISOTOPE BATTERIES;POWER REACTORS;USES; COMPARATIVE EVALUATIONS

5215 ADVANCE DEPLOYABLE SOLAR CELL BATTERY POWER SYSTEM DEVELOPMENT. Shinbrot, C.H.; Tonelli, A.D. (McDonnell Douglas Astronautics Co.). pp 152-62 of 1971 Intersociety Energy Conversion Engineering Conference, Boston, Massachusetts, August 3-5, 1971. New York; Society of Automotive Engineers, Inc. (1971).

From 6. intersociety energy conversion engineering conference; Boston, Massachusetts, USA (3 Aug 1971).

SOLAR CELL ARRAYS;PERFORMANCE TESTING; SPACECRAFT POWER SUPPLIES;ELECTRIC BATTERIES; ELECTRICAL PROPERTIES;THERMAL CYCLING; FABRICATION

5216 HYDROGEN AND THE ELECTRIC ECONOMY. Deen, J.L. (Oklahoma State Univ., Stillwater, OK); Schoeppel, R.J. (Oklahoma Gas and Electric Co., Public Service Co., OK). pp 1 of Proceedings of the Frontiers of Power Technology Conference. Stillwater, OK; Oklahoma State Univ. (1971).

From Frontiers of Power Technology Conference; Stillwater, OK (30 Sep-1 Oct 1971).

DIRECT ENERGY CONVERSION;HYDROGEN PRODUCTION; ELECTROLYSIS;ELECTRIC-POWERED VEHICLES;INTERNAL COMBUSTION ENGINES;ELECTRIC BATTERIES;HYDROGEN FUEL CELLS

5217 DEVELOPMENT OF HIGH PERFORMANCE ELECTRIC VEHICLES AND SUPPORT SYSTEMS. Goldman, W. pp 112-117 of 6th Intersociety energy conversion engineering conference. New York; Society of Automotive Engineers, Inc. (1971).

From 6. Intersociety energy conversion engineering conference; Boston, MA (3 Aug 1971).

ELECTRIC-POWERED VEHICLES;LEAD-ACID BATTERIES;USES;DESIGN;PERFORMANCE;AUTOMOBILES

5218 POWER SYSTEM COMPONENTS FOR BATTERY ELECTRIC VEHICLES. Hender, B.S. pp 147-151 of 6th Intersociety energy conversion engineering conference. New York; Society of Automotive Engineers, Inc. (1971).

From 6. Intersociety energy conversion engineering conference; Boston, MA (3 Aug 1971).

ELECTRIC-POWERED VEHICLES;ECONOMICS; OPTIMIZATION;DESIGN;ELECTRIC BATTERIES;ELECTRIC POTENTIAL

5219 EVALUATION OF HYBRID HEAT ENGINE/ ELECTRIC SYSTEMS FOR LOW EXHAUST EMISSION POTENTIAL IN AUTOMOTIVE APPLICATIONS. Lapedes, D.E.; Meltzer, J. pp 1151-1162 of 6th Intersociety energy conversion engineering conference. New York; Society of Automotive Engineers, Inc. (1971).
From 6. Intersociety energy conversion engineering conference; Boston, MA (3 Aug 1971).
HYBRID ELECTRIC-POWERED VEHICLES;AUTOMOBILES; HYBRID SYSTEMS;EXHAUST GASES;HEAT ENGINES; DESIGN;PERFORMANCE;FEASIBILITY STUDIES; SPECIFICATIONS;ELECTRIC BATTERIES;HYDROCARBONS; CARBON MONOXIDE;NITROGEN OXIDES

5220 DEVELOPMENT OF HIGH PERFORMANCE ELECTRIC VEHICLES AND SUPPORT SYSTEMS. Goldman, W. pp 112-117 of 1971 intersociety energy conversion engineering conference. New York; Society of Automotive Engineers, Inc. (1971).
From Intersociety energy conversion engineering conference; Boston, MA (3 Aug 1971).
Replaceable battery packs. ELECTRIC-POWERED VEHICLES;DESIGN;LEAD-ACID BATTERIES;COST; MAINTENANCE;AUTOMOBILES

5221 POWER SYSTEM COMPONENTS FOR BATTERY ELECTRIC VEHICLES. Hender, B.S. pp 147-151 of 1971 intersociety energy conversion engineering conference. New York; Society of Automotive Engineers, Inc. (1971).
From Intersociety energy conversion engineering conference; Boston, MA (3 Aug 1971).
ELECTRIC-POWERED VEHICLES;ELECTRIC BATTERIES; ECONOMICS;COST;DESIGN;ENERGY CONSUMPTION; CONTROL SYSTEMS

5222 PROCEEDINGS OF THE SECOND INTERNATIONAL ELECTRIC VEHICLE SYMPOSIUM, ATLANTIC CITY, NJ, 8-10 NOV 1971. New York; Electr. Veh. Council (1971). 784p.
From 2. international electric vehicle symposium; Atlantic City, NJ (8-10 Nov 1971).
ELECTRIC-POWERED VEHICLES;MEETINGS;NEW JERSEY;SEMICONDUCTOR MATERIALS;AIR POLLUTION; AUTOMOBILES;TRAINS;ELECTRIC BATTERIES;RESEARCH PROGRAMS;HYBRID ELECTRIC-POWERED VEHICLES; FLYWHEELS

5223 ELECTRIC VEHICLE DEVELOPMENT IN JAPAN. Nakahara, S. (Jap. Minist. of Int. Trade and Ind., Tokyo). Bucharest; Rom. Natl. Comm. of World Energy Conf. (1971). 20p.
From 8. world energy conference; Bucharest, Romania (28 Jun-2 Jul 1971).
ELECTRIC-POWERED VEHICLES;ELECTRIC BATTERIES; JAPAN;FORECASTING

5224 DUAL BATTERY ELECTRIC POWERPLANT. Hietbrink, E.H.; Winebrener, G.L.; Witherspoon, R.R. New York; Society of Automotive Engineers (1971). 8p.
General Motors has powered an Opel Kadett with a set of mechanically rechargeable zinc--air batteries, which have sufficient power density to have potential as a power source for low performance vehicles. A lead--acid battery system is used as the augmenting power source. Control is provided by a frequency and pulse width modulation system. Testing developed two problems that preclude economical production of this propulsion system--excessive electrolyte evaporation and the difficulty of keeping batteries at operating temperature (150°F) while maintaining adequate air distribution to prevent cathode oxygen starvation.

5225 SECONDARY ALKALI METAL--CHALCOGEN BATTEREIS IN URBAN TRANSPORTATION. Ng, D.Y.C.; Appleby, A.J. (Inst. of Gas Tech., Chicago). pp 265-282 of Seventh international symposium on power sources. III. Collins, D.H. (ed.). Newcastle upon Tyne, Eng.; Oriel Press (1971).
The possibility that a Li/S battery system could meet the power needs of an urban bus are considered. (RWR)

5226 NO-BREAK POWER SUPPLY FOR RADIO LINK STATIONS IN VENEZUELA. Ungeheuer, E. AEG-Telefunken Prog.; No. 4, 122-125(1971).
The construction and method of operation of no-break power supply equipment for radio link stations in Venezuela are described. The power supply equipment works either from the public network with a standby generating set or with two Diesel sets in continuous duty. Two self-regulating chargers feed two lead--acid batteries, to which the radio link equipment is connected. The main components of the installations are described in detail.

5227 UNINTERRUPTED POWER SUPPLY FOR RADIO RELAY STATIONS IN VENEZUELA. Ungeheuer, E. Tech. Mitt. AEG-Telefunken; 61: No. 3, 171-174(1971). (In German).
The power supply is either from the public network with a standby station, or by two Diesel power plants in continuous operation. Two self-regulating charging devices are used for supplying two lead storage batteries. Details are given on the main components of the power supply installations.

5228 ELECTRIC CAR AND LEAD ACID BATTERIES. Kozawa, A.; Kozawa, S. Tokyo; Yayoi Publishing Co. (1971). 154p. $16.50.
Two-man summer research study. ELECTRIC-POWERED VEHICLES;LEAD-ACID BATTERIES; AUTOMOBILES;PERFORMANCE TESTING;PERFORMANCE; FORECASTING

5229 NEMO PROVIDES NEW LOOK AT OCEAN DEPTHS. Undersea Technol.; 11: No. 6, 28-29(Jun 1970).
The Navy's new NEMO acrylic submersible made of Rohm and Haas Plexiglas G is $2^1/_2$ in. thick and bonded with a special acrylic adhesive. The 66-in.-diam sphere, constructed from 12 identical curved pentagons, was successfully tested to a depth of 500 ft. Life support for the NEMO is an oxygen bleed system and a baralyme absorbent system capable of sustaining two men for 8 h, plus 24 h in an emergency. The vehicle has two independent power sources. The main power supply, located in the service module below the sphere, consists of 21 Exide 6-V lead--acid batteries. The life-support emergency power supply, located inside the pressure hull, is a silver--zinc 24-V dc battery. In operation, NEMO is lowered into the water from a surface support ship. Ballast tanks are flooded for controlled descent. When NEMO reaches a desired depth, crewmen operate a winch in the service module to lower an anchor for station keeping. The crew can also winch the craft downward and upward along the anchor cable as the situation requires. By adjusting the ballast, the vehicle can also be tilted forward for a better view, and two reversible rotation motors are used to turn the submersible.

5230 NEMO PROVIDES NEW LOOK AT OCEAN DEPTHS. Undersea Technol.; 11: No. 6, 28-29(Jun 1970).
The Navy's new NEMO acrylic submersible,

made of Rohm and Haas Plexiglas G, is $2^1/_2$ in. thick and bonded with a special acrylic adhesive. The 66 in. diam sphere, constructed from 12 identical curved pentagons, was successfully tested to a depth of 500 ft. Life support for the NEMO is an oxygen bleed system and a baralyme $CO_2$ absorbent system capable of sustaining two men for 8 h, plus 24 h in an emergency. The vehicle has two independent power sources. The main power supply, located in the service module below the sphere, consists of 21 Exide 6-V lead--acid batteries. The life-support emergency power supply, located inside the pressure hull, is a silver--zinc 24-V dc battery. In operation, NEMO is lowered into the water from a surface support ship. Ballst tanks are flooded for controlled descent. When NEMO reaches a desired depth, crewmen operate a winch in the service module to lower an anchor for station keeping. The crew can also winch the craft downward and upward along the anchor cable as the situation requires. By adjusting the ballast, the vehicle can also be tilted forward for a better view, and two reversible rotation motors are used to turn the submersible.

5231 COMPATIBLE CONTROLLER--MOTOR SYSTEM FOR BATTERY-ELECTRIC VEHICLE. Byrne, J.V. (University Coll., Dublin); Lacy, J.G. Proc. Inst. Electr. Eng. (London); 117: No. 2, 369-376(Feb 1970).

The thyristor controller and the dc motor of a battery-electric vehicle are considered as a system. The advantage of combining a current-controlled chopper regulator, using digital techniques, with a laminated-field series motor is outlined, design criteria are suggested, and an experimental system is described. Performance measurements using specially developed wattmeters are presented, which show the division of losses in the system, and the exceptionally high overall efficiencies over the speed range.

5232 FIRST TRANSCONTINENTAL ELECTRIC EXPRESSWAY. Francis, R. (MIT, Cambridge, MA). pp 38-9 of NEREM record, technical application papers. Volume 12. New York; IEEE (1970).

From IEEE northeast electronics research and engineering meeting; New York (1970).

ELECTRIC-POWERED VEHICLES;ROADS;BATTERY CHARGING

5233 WPI ELECTRIC HYBRID. Clarke, S.A.; Sousa, N.W.; Maymon, K.; Nowak, D. pp 40-1 of NEREM record, technical application papers. Volume 12. New York; IEEE (1970).

From IEEE northeast electronics research and engineering meeting; New York (1970).

Battery + constant-speed generator. HYBRID ELECTRIC-POWERED VEHICLES;OPERATION;ELECTRIC GENERATORS;ELECTRIC BATTERIES

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5237 QUESTIONS TO ASK ABOUT BATTERIES PROPOSED FOR ELECTRIC CARS. Ammermann, F.A. New York; Society of Automotive Engineers, Inc. (1970). 7p.

This assessment of battery technology aims to provide working criteria for the evaluation and selection of batteries in automotive propulsion applications. Certain assumptions are derived and recommended as guidelines. It is assumed that optimum system performance will not exceed 20% of theoretical capacity and that any improvement in performance will come from product and process development. Any modification of known systems involving chemical changes is assumed to require consideration as a totally new system.

5238 EXPERIMENTAL BATTERY-POWERED FORD CORTINA ESTATE CAR. Foote, L.R.; Hough, J.F. New York; Society of Automotive Engineers, Inc. (1970). 8p.

The drive train of this converted Cortina consists of a light weight dc commutator motor rated at 40 hp, 100 V and 26.4 lb-ft torque at 8000 rpm. The motor is geared to the rear wheels through a 3.0 to 1 rear axle and 2.23 to 1 transmission, resulting in a vehicle speed of 58.6 mph at 8000 rpm motor speed. Paralleled thyristors are used as electronic time ratio controllers. 90 nickel--cadmium aircraft-type cells are connected in series, 10 cells per battery. Each battery is rated 110 Amph at 1-h rate. At a constant 25 mph driving speed, a range of 39.9 mi is obtained.

5239 DESIGN CONSIDERATIONS FOR AN ELECTRIC CAR. Thornton, R.D. New York; Society of Automotive Engineers, Inc. (1970). 6p.

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5240 DRIVING CHARACTERISTICS AND POWER REQUIREMENT OF BATTERY DRIVEN ROAD VEHICLES. Deleroi, W.; Weh, H. Elektrotech. Z., A; 90: No. 16, 383-388(1 Aug 1969). (In German).

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5382 SEVERE GRADES, HEAVY LOADS FEATURE INDUSTRIAL TRUCK OPERATIONS AT FRED MEDART DIVISION. Storage Battery Power; 19: No. 1, 8-10(Feb 1949).
MATERIALS HANDLING;SHEETS;STEELS;TRUCKS; ELECTRIC BATTERIES;ELECTRIC-POWERED VEHICLES; OPERATION

5383 BATTERY LOCOMOTIVE HAULAGE AT TENNESSEE COPPER'S MINES. Weaver, L. Eng. Min. J.; 149: No. 12, 88-91(Dec 1948).
TRAINS;ELECTRIC BATTERIES;ELECTRIC-POWERED VEHICLES;SAFETY;EXPLOSIONS;ECONOMICS

5384 HOW STORAGE BATTERY POWERED TRUCKS CUT MATERIALS HANDLING TIME. Pap. Trade J.; 127: No. 15, 60-61(7 Oct 1948).
ELECTRIC-POWERED VEHICLES;MATERIALS HANDLING; ELECTRIC BATTERIES;USES

5385 FRED RUEPING LEATHER COMPANY SPEEDS PRODUCTION BY PROCESSING DRESS CATTLEHIDE IN SKID LOTS. Storage Battery Power; 18: No. 4, 8-10(Oct 1948).
MATERIALS HANDLING;ELECTRIC BATTERIES; ELECTRIC-POWERED VEHICLES;TRUCKS;OPERATION

5386 VARIETY OF PLANT TRUCKS USED TO RELAY WORK THROUGH PROCESSING LINES. Steel; 123: No. 3, 107, 110(19 Jul 1948).
TRUCKS;ELECTRIC-POWERED VEHICLES;ELECTRIC BATTERIES;COMPARATIVE EVALUATIONS

5387 STORAGE BATTERY VEHICLE WITH SPECIAL CONSIDERATION OF ELECTRIC AUTOMOBILE. Urban, F. Elektrotech. Z., A; 69: No. 7, 226-228(Jul 1948). (In German).
Data on several types of batteries. ELECTRIC-POWERED VEHICLES;AUTOMOBILES;ELECTRIC BATTERIES; COMPARATIVE EVALUATIONS

5388 ELECTRIC TRUCKS IN BRICK INDUSTRY. Mech. Handl.; 35: No. 6, 317-319(Jun 1948).
ELECTRIC BATTERIES;ELECTRIC-POWERED VEHICLES; TRUCKS;PERFORMANCE

5389 PRATT AND WHITNEY AIRCRAFT HAS MODEL BATTERY SHOP FOR SUPPLYING INDUSTRIAL TRUCKS WITH POWER. Storage Battery Power; 18: No. 1, 8-6, 15(Apr 1948).
TRUCKS;ELECTRIC-POWERED VEHICLES;ELECTRIC BATTERIES;MAINTENANCE;BATTERY CHARGING

5390 BATTERY-DRIVEN DUMP TRUCK. Engineer; 185: No. 4803, 167(13 Feb 1948).
Loads < 0.75 ton. TRUCKS;ELECTRIC-POWERED VEHICLES;ELECTRIC BATTERIES;DESIGN

5391 ELECTRICITY VS GASOLINE. Koehlmann, H. Werkstatt Betr.; 81: No. 2, 34-35(Feb 1948). (In German).
Principles, advantages, and uses of electric automobiles. AUTOMOBILES;ELECTRIC-POWERED VEHICLES;COMPARATIVE EVALUATIONS;INTERNAL COMBUSTION ENGINES;USES;BATTERY CHARGING; ELECTRIC BATTERIES

5392 BATTERY ELECTRIC VEHICLES. Automob. Eng.; 38: No. 498, 63-68(Feb 1948).
Survey of development trends revealed in patent literature. ELECTRIC-POWERED VEHICLES; AUTOMOBILES;REVIEWS;ELECTRIC BATTERIES

5393 STORAGE BATTERIES IN GENERATING STATIONS AND SUBSTATIONS. Sanderson, E.R. Electr. Rev. (London); 142: No. 3661, 119-122(23 Jan 1948).
LEAD-ACID BATTERIES;POWER PLANTS;PUBLIC UTILITIES;USES;ECONOMICS

5394 PENTAGON, NATIONAL DEFENSE BUILDING, WORLD'S LARGEST OFFICE BUILDING, HAS MODERN INDUSTRIAL-TRUCK HANDLING SYSTEM. Storage Battery Power; 17: No. 6, 9-12(Dec 1947).
TRUCKS;ELECTRIC BATTERIES;ELECTRIC-POWERED VEHICLES;USES

5395 BAKER AND WILLIAMS ADOPT PALLET--FORK--TRUCK SYSTEM TO SIMPLIFY WAREHOUSE HANDLING. Storage Battery Power; 17: No. 6, 6-8(Dec 1947).
2000-lb capacity. TRUCKS;MATERIALS HANDLING; OPERATION;ELECTRIC-POWERED VEHICLES;ELECTRIC BATTERIES;BATTERY CHARGING

5396 TIN PLATE TRANSPORTATION. Steel; 121: No. 11, 106, 109(15 Sep 1947).
Materials handling with battery-powered trucks. INDUSTRIAL PLANTS;TRUCKS;OPERATION; PERFORMANCE;ELECTRIC-POWERED VEHICLES;ELECTRIC BATTERIES;TIN;PLATES;SHEETS;MATERIALS HANDLING; USES;MAINTENANCE;STEELS

5397 ELECTRIC INDUSTRIAL TRUCK FOR MATERIAL HANDLING. Kells, C.F. EEI (Edison Electr. Inst.) Bull.; 15: No. 9, 317-320(Sep 1947).
TRUCKS;ELECTRIC-POWERED VEHICLES;MATERIALS HANDLING;ELECTRIC BATTERIES;USES

5398 BATTERY AND ELECTRIC INDUSTRIAL TRUCK. Mech. Handl.; 34: No. 9, 483-487(Sep 1947).
ELECTRIC BATTERIES;ELECTRIC-POWERED VEHICLES; TRUCKS;RECOMMENDATIONS;OPERATION;MAINTENANCE

5399 RITTER CO., INC., HANDLES MULTIPLICITY OF PARTS THROUGH PROCESS BY SKID-LIFT-TRUCK SYSTEM. Storage Battery Power; 17: No. 1, 9-11(Feb 1947).
TRUCKS;ELECTRIC BATTERIES;ELECTRIC-POWERED VEHICLES;MATERIALS HANDLING;USES

5400 ELECTRIC VEHICLES' CHANCE. Ridley, C. Electr. Times; 111: No. 2884, 140-141(30 Jan 1947).
Battery development. ELECTRIC-POWERED VEHICLES;COST;ELECTRIC BATTERIES;MAGNESIUM

5401 SMALL BATTERY ELECTRIC TRUCK. Engineer; 182: No. 4741, 475(22 Nov 1946).
3-wheeled vehicle with 18-cwt capacity. ELECTRIC BATTERIES;ELECTRIC-POWERED VEHICLES; TRUCKS;TRANSPORT;USES

5402 INTRA-PLANT TRANSPORTATION EXPEDITED BY BATTERY TRUCKS. Steel; 119: No. 19, 106, 116(4 Nov 1946).
TRUCKS;ELECTRIC-POWERED VEHICLES;MATERIALS HANDLING;TRANSPORT;ELECTRIC BATTERIES; INDUSTRIAL PLANTS;OPERATION;INSPECTION; MAINTENANCE

5403 PRESENT STATUS AND FURTHER DEVELOPMENT OF ELECTRIC MOTOR VEHICLE. Koehlmann, H. Automobiltech. Z.; 48: No. 2, 19-20(Sep 1946). (In German).
Electricity vs gasoline. ELECTRIC-POWERED VEHICLES;COMPARATIVE EVALUATIONS;ELECTRIC BATTERIES;BATTERY CHARGING;AUTOMATION

5404 BATTERY LOCOMOTIVE AT CALVERTON COLLIERY. Crossland, J.W. Iron Coal Trades Rev.; 153: No. 4096, 369-376(30 Aug 1946).
RAILWAYS;ELECTRIC-POWERED VEHICLES;ELECTRIC BATTERIES;PERFORMANCE;ENERGY CONSUMPTION;POWER DEMAND;BATTERY CHARGING;MAINTENANCE

5405 MATERIALS HANDLING AT HUBBARD ACCELERATED BY LIFT TRUCKS. French, I.S. Ind. Power; 51: No. 2, 73-74(Aug 1946).
MATERIALS HANDLING;TRUCKS;ELECTRIC BATTERIES; ELECTRIC-POWERED VEHICLES;MAINTENANCE;OPERATION; INSPECTION

5406 HANDLING 23,000-POUND COILS AT COLD STRIP MILLS. Steel; 118: No. 25, 128-130(24 Jun 1946).
MATERIALS HANDLING;TRUCKS;ELECTRIC-POWERED VEHICLES;ELECTRIC BATTERIES;MAINTENANCE;COST; OPERATION;USES

5407 MORE POWER TO YOU. Paul, V.J. Flow; 1: No. 6, 56-58(Mar 1946).
MAINTENANCE;BATTERY CHARGERS;BATTERY CHARGING;TRUCKS;ELECTRIC-POWERED VEHICLES; ELECTRIC BATTERIES

5408 ELECTRIC BATTERY TRUCKS IN CERAMICS INDUSTRY. Mech. Handl.; 33: No. 3, 143-144(Mar 1946).
ELECTRIC BATTERIES;TRUCKS;ELECTRIC-POWERED VEHICLES;CERAMICS;COMPARATIVE EVALUATIONS; INDUSTRY

5409 DIRECT-CURRENT POWER FOR AIRCRAFT. Cunning, J.C. Westinghouse Eng.; 6: No. 2, 57-61(Mar 1946).
AIRCRAFT;DIRECT CURRENT;ELECTRIC GENERATORS; ELECTRIC BATTERIES;ELECTRIC MOTORS;CONTROL SYSTEMS;PLANNING

5410 MATERIALS HANDLING. Mech. Handl.; 33: No. 2, 83-88(Feb 1946).
MATERIALS HANDLING;TRUCKS;PRODUCTION;

ELECTRIC-POWERED VEHICLES;ELECTRIC BATTERIES; USES

5411 ELECTRIC TRUCKS OF THE NOVEL DESIGN AND THEIR POSSIBLE USES. Roffler, C. Brown Boveri Rev.; 33: No. 6-7, 137-142(1946).
ELECTRIC-POWERED VEHICLES;TRUCKS;DESIGN;USES; ELECTRIC BATTERIES;BATTERY CHARGERS

5412 NEW DESIGN OF ELECTRIC BATTERY. Passeng. Transp. J.; 93: No. 2358, 169-171(14 Sep 1945).
Mechanical operating, body, and electrical equipment features of $^{1}/_{2}$- to $^{3}/_{4}$-ton panel truck. ELECTRIC BATTERIES;DESIGN;TRUCKS; ELECTRIC-POWERED VEHICLES;OPERATION;ELECTRICAL EQUIPMENT

5413 AMERICAN FORK AND HOE CO. HANDLES WORK BY COMBINATION SKID-LIFT-TRUCK AND TRACTOR-TRAILER SYSTEMS. Storage Battery Power; 15: No. 4, 11-14(Aug 1945).
MATERIALS HANDLING;ELECTRIC BATTERIES;TRUCKS; BATTERY CHARGING;ELECTRIC-POWERED VEHICLES;USES

5414 BRITISH INDUSTRIAL TRUCKS. Mech. Handl.; 32: No. 3, 148-150(Mar 1945).
TRUCKS;UNITED KINGDOM;ELECTRIC-POWERED VEHICLES;ELECTRIC BATTERIES

5415 WORKS TRANSPORT. Denshi Tenbo; 136: No. 3508, 225-227(16 Feb 1945).
MATERIALS HANDLING;ELECTRIC-POWERED VEHICLES; TRUCKS;USES;EXPLOSIONS;ELECTRIC BATTERIES

5416 ELECTRICITY FOR TRANSPORT. Ridley, C. Mech. World; 117: No. 3027, 1-4(5 Jan 1945).
ELECTRIC-POWERED VEHICLES;FORECASTING; ECONOMICS;TRANSPORT;RANGE;PRODUCTION;VELOCITY

5417 SHUNTING LOCOMOTIVES. Iron Steel (London); 17: No. 17, 720(Dec 1944).
RAILWAYS;ELECTRIC-POWERED VEHICLES;ELECTRIC BATTERIES

5418 CHICAGO PNEUMATIC TOOL CO. APPLIES SKID-LIFT-TRUCK SYSTEM TO MULTISTORY PLANT. Storage Battery Power; 14: No. 6, 8-9(Dec 1944).
MATERIALS HANDLING;ELECTRIC BATTERIES;TRUCKS; ELECTRIC-POWERED VEHICLES;BATTERY CHARGING; DIRECT CURRENT;OPERATION;USES

5419 BRITISH INDUSTRIAL TRUCKS. Mech. Handl.; 31: No. 12, 612-615(Dec 1944).
TRUCKS;UNITED KINGDOM;ELECTRIC BATTERIES; ELECTRIC-POWERED VEHICLES;ELECTRIC MOTORS

5420 GLOBE MACHINE AND STAMPING CO. EASES MANPOWER SHORTAGE BY ADOPTION OF POWER TRUCKING. Storage Battery Power; 14: No. 6, 13-14(Dec 1944).
TRUCKS;ELECTRIC-POWERED VEHICLES;ELECTRIC BATTERIES;OPERATION

5421 BATTERY-ELECTRIC VEHICLES. Hills, S.M. London; George Newnes, Ltd. (1943). 206p.
Book. ELECTRIC-POWERED VEHICLES;ELECTRIC BATTERIES;TRUCKS;RAILWAYS;BUSES;AUTOMOBILES; BATTERY CHARGERS;MAINTENANCE;USES

5422 (AD--639489) REPLACEMENT OF LEAD ACID STORAGE BATTERIES WITH ALKALINE ONES ON 'ROCKET' TYPE SHIPS. Andreev, N.; Nalebin, V. [nd]. Translated from Rechnoi Transport; No. 7, 42-43(7 Jun 1966). (FTD-TT--65-1879). 2p. NTIS $3.00.
ELECTRIC BATTERIES;HYDROXIDES;LEAD-ACID BATTERIES;SHIPS;USES

<>
<TITLE>Fabrication and characterization of sodium sulfur
battery
<PROJ NO>2037
<DURATION>06/73-06/77
<INVESTIG>Gordon, R.S.; Miller, G.R.
<PHONE>C(801)581-6612
<RES ORG>Utah Univ., Salt Lake City. Div. of Materials
Science and Engineering
<ZIP CODE>84112
<LOCATION>UT
<SP NAME>Ford Motor Co., Dearborn, Mich. ; Utah Univ.,
Salt Lake City
<FUNDING>252.4;281.7;0
<DESCRIPT>In 1973 the Department of Materials Science
and Engineering at the University of Utah entered into
a sub-contract with the Ford Motor Company and the
National Science Foundation (RANN) to conduct research
on the fabrication and characterization of the ceramic
beta-alumina membrane which is the electrolyte for
the sodium-sulfur battery. Since over a billion ceramic
tubes will be needed eventually on an annual basis,
it is essential that economical fabrication techniques
be developed for the manufacture of these ceramic electrolytes.
This project involves extensive studies on powder development,
synthesis and characterization, tubular green forming
techniques such as isostatic pressing and extrusion;
high temperature (1400-1650 degrees C) sintering and
firing operations; and optimization of electrolyte
properties such as strength, electrical conductivity,
thermal shock and creep resistance as a function of
the microstructure. It is essential that thin-walled
beta (approximately 1 mm) beta alumina tubing be available
at an economical price and possess optimal electrical
and mechanical properties. In addition to work on the
ceramic electrolyte, work was also initiated in July
1975 on the development of a ceramic container and/or
current collector for the cathode (sulfur) of the sodium-sulfur
battery. In this application the ceramic must be (1)
resistant to corrosive attack by molten sulfur and
sodium polysulfide at 300-400 degrees C and (2) a good
conductor of electrons. A cooperative effort between
faculty in the Physics and Materials Science and Engineering
Departments has resulted in the development an electronic
ceramic (TiO2) which is currently under consideration
for use in the sodium-sulfur battery as the cathode
container and current collector.
<CONT OFF>Gordon, R.S.
<COOPERAT>National Science Foundation (ERDA)

<>
<TITLE>Electrical energy from waste wood
<DURATION>03/77-02/80
<INVESTIG>Steelink, C.
<PHONE>C(602)884-2780
<RES ORG>Arizona Univ., Tucson. Dept. of Chemistry
<ZIP CODE>85721
<LOCATION>AZ
<SP NAME>Arizona Univ., Tucson. Dept. of Chemistry
<FUNDING>0;37;37
<DESCRIPT>Pyrolyzed wood, sawdust, particle board,
newsprint and other wood wastes have been shown to
retain electrical charges. This project is seeking
to characterize the electroactive groups in these pyrolysates,
to maximize their concentration, so that working batteries
can be constructed from these wastes.
<CONT OFF>Steelink, C.
<CO ADD>Chemistry Dept., University of Arizona, Tucson,
AZ 85721, C(602)884-2780
<AUGMENT>Univ. Arizona

>
<TITLE>Electrochemical energy conversion and storage--general
<PROJ NO>988-15-990.6011
<DURATION>1974-continuing
<INVESTIG>Siegel, G.R.
<RES ORG>Tennessee Valley Authority, Chattanooga. Office
of Power
<ZIP CODE>37401
<LOCATION>TN
<SP NAME>Tennessee Valley Authority, Chattanooga. Office
of Power
<FUNDING>12;31;32
<DESCRIPT>The project objectives are to follow research,
development, and demonstration programs in the area
of electrochemical energy conversion and storage; to
assess the potential application of electrochemical
energy conversion and storage devices to the TVA power
system, recommending when appropriate TVA participation
in research projects to develop especially promising
technologies; to work with EPRI to develop and coordinate
the research programs of EPRI and other organizations.
Research, development, and demonstration programs related
to electrochemical energy conversion and storage (batteries,
fuel cells, hydrogen production) are followed, and
the technical and economic feasibility (including commercial
applicability) of utilizing devices based on these
concepts in the TVA power system is assessed in-house
or with the aid of consultants. Participation in national
conferences and in EPRI industry advisory task forces
and project committees in this subject area gives TVA
the opportunity to closely follow and influence national
programs aimed at developing the various conversion
and storage possibilities to the point of commercial
availability. Review and evaluation of research related
to developing energy conversion and storage devices
and assessing their potential for application to power
systems are on-going continuous functions of the Power
Research Staff.
<RO TYPE>TVA

<>
<TITLE>Pre-pilot development of beta''-Al2O3 electrolytes
for the sodium sulfur battery
<PROJ NO>2036
<DURATION>01/76-10/77
<INVESTIG>Gordon, R.S.
<PHONE>C(801)581-6612
<RES ORG>Utah Univ., Salt Lake City. Div. of Materials
Science and Engineering
<ZIP CODE>84112
<LOCATION>UT
<SP NAME>Ford Motor Co., Dearborn, Mich.
<FUNDING>0;410.4;0
<DESCRIPT>The objectives of this program include (1)
the development of isostatic pressing techniques and
sintering methods for large (3 cm OD, 46 cm long, 2
+- 1 mm wall) electrolyte tubing of polycrystalline
beta''-Al2O3. (2) Scaling-up of the continuous, pass-through
sintering process for the firing of tubes of beta''-Al2O3
with the size, 1.5 cm OD, 20 cm long and 1 mm wall.
(3) Transfer of alpha-beta'' sealing technology from
Ford. (4) Batch production of beta''-Al2O3 tubing (1.5-3.0
cm OD, 20-30 cm long, 1-3 mm wall) at rates up to 200/month
in a pre-pilot facility (batch plant) which will be
placed into operation by October 1976. (5) Non-destructive
electrical impedance measurements on polycrystalline
beta''-Al2O3 over a range of frequencies. (6) Measurements
of elastic modulus and thermal expansion on polycrystalline
beta''-Al2O3. This pre-pilot electrolyte development
and evaluation program will be conducted in Phases
I, II, and III on facilities at the University of Utah.
This project has been subcontracted.
<CONT OFF>Gordon, R.S.
<CO ADD>Dept. of Mat. Sci. and Engineering, U of Utah,
Salt Lake City, UT84112
<COOPERAT>Energy Research and Development Administration,
Dr. Albert Landgrebe, 20 Massachusetts Ave., Washington,
DC

<>
<TITLE>Environmental issues of energy storage systems
<PROJ NO>00025041
<DURATION>04/76-Indefinite
<INVESTIG>Malenfant, R.E.; Gertsch, W.D.
<RES ORG>Los Alamos Scientific Lab., N.Mex.
<ZIP CODE>87545
<LOCATION>NM
<SP NAME>Energy Research and Development Administration,
Washington, D.C.
<FUNDING>42;0;0
<DESCRIPT>The purpose of this project is to assist
ERDA to ensure the timely development of control technologies
for energy storage needs. The objectives of the project
are (1) define the environmental issues which may arise
from the increased use of energy storage systems batteries,
pumped hydro, magnetic, compressed air, flywheels,
and thermal energy storage; (2) identify the available
and advanced technology to control adverse health and
environmental effects; (3) evaluate the efficacy and
practicability of control options relative to existing,
proposed or anticipated standards; and (4) recommend
specific strategies for the development of control
technologies consistent with the timing of the implementation
of the storage systems.
<RO TYPE>FF

<>
<TITLE>Pilot plant development of B''-Al2O3 electrolytes
for the sodium-sulfur battery
<PROJ NO>4190
<DURATION>06/76-10/77
<INVESTIG>Gordon, R.S.
<PHONE>C(801)581-6612
<RES ORG>Utah Univ., Salt Lake City. Research Inst.
<ZIP CODE>84108
<LOCATION>UT
<SP NAME>Ford Motor Co., Dearborn, Mich.
<FUNDING>0;802.7;0
<DESCRIPT>In cooperation with Ford and funded by the Energy Research and Development Administration, a program has begun on the pilot-plant production of beta alumina electrolyte tubing. This pilot-plant, which is to be located in the Research Park of the University of Utah, will be used to supply electrolytes for two prototype sodium-sulfur batteries: (1) a 35 kilowatt peak power battery for test in an electric vehicle and (2) a one megawatt storage battery for test in the National Battery Energy Storage Test (BEST) Facility operated in conjunction with the government (ERDA), the Electric Power Research Institute (EPRI) and representatives from the electric utilities. This five year program will be funded at approximately 18 million dollars, with the University's (including the Research Institute) share comprising about 3 million. Once successful prototype batteries have been tested in the BEST facility and in electric cars, commercial production of sodium-sulfur batteries should begin in the early 1980's. The state of Utah should be in a very advantageous position at that time for the formation of a local industry which can supply beta alumina electrolyte tubing and possibly electronic ceramic cathode containers for sodium-sulfur battery production. The pilot plant will be capable of producing annually 40,000-113,000 units of sealed beta''-Al2O3 tubing of various sizes which will be suitable for use as the electrolyte in the sodium-sulfur battery. This project has been subcontracted.
<CONT OFF>Gordon, R.S.
<CO ADD>Bathery Ceramics Laboratory, University of Utah Research Institute, Research Park, Univ. of Utah, SLC, Utah 84108
<COOPERAT>Energy Research and Development Administration, Dr. Albert Landgrebe, 20 Massachusetts Avenue, Washington, D.C.

<>
<TITLE>Electroactive species in pyrolyzed lignocellulose:
substrates for stored electrical energy
<DURATION>04/77-03/79
<INVESTIG>Steelink, C.; Wilson, G.S.
<PHONE>C(602)884-2780
<RES ORG>Arizona Univ., Tucson. Dept. of Chemistry
<ZIP CODE>85721
<LOCATION>AZ
<SP NAME>National Science Foundation, Washington, D.C..
Div. of Engineering
<FUNDING>0;28;28
<DESCRIPT>Lignin and cellulose are the major components
of sawdust, newsprint, municipal solid wastes and other
byproducts of the wood and pulp industry. In our laboratory,
these waste products have been converted to solids
which conduct electricity and retain an electrical
charge. Working batteries have been constructed from
these solids. In this proposal, we plan to examine
the chemical nature of these solids in order to optimize
their performance for low-cost storage batteries.
<CONT OFF>Steelink, C.
<CO ADD>Chemistry Department, University of Arizona,
Tucson, AZ 85721, C(602)884-2780

<>
<TITLE>Energy conversion: effects of adsorption on
efficiency of fuel-cell and battery electrodes
<PROJ NO>DN823376, N00014-67-A-0299-0007
<DURATION>07/75-06/76
<INVESTIG>Osteryoung, R.A.
<PHONE>C(202)381-5511
<RES ORG>Colorado State Univ., Fort Collins. Dept.
of Chemistry
<ZIP CODE>80521
<LOCATION>CO
<SP NAME>Department of the Navy, Washington, D.C.
<FUNDING>20;0;0
<DESCRIPT>The efficiency of direct-current power sources,
such as batteries and fuel-cells used by the Navy or
contemplated for use, depends on the efficiency of
the individual electrodes involved. It is the purpose
of this research to elucidate the factors which adversely
affect the course of fast electrode reactions. The
adsorption of molecules and ions at the electrode/electrolyte
interface and the course of fast electrode reactions
are studied by observing electrical relaxation phenomena.
Digital computer control and analysis of the experiments
are an important part of this research.

<>
<TITLE>Electrochemistry of solutes in chloroaluminate
systems
<DURATION>07/75-06/76
<INVESTIG>Osteryoung, R.A.
<PHONE>C(202)381-5511
<RES ORG>Colorado State Univ., Fort Collins. Dept.
of Chemistry
<ZIP CODE>80521
<LOCATION>CO
<SP NAME>Department of the Air Force, Washington, D.C.

<FUNDING>50;0;0
<DESCRIPT>Communications and flight operations depend
on auxiliary battery sources for power. Lighter-weight,
higher-temperature, longer-life, and higher-energy
batteries are needed to meet the requirements. This
research involves an understanding of the solution
processes by which solute materials interact with certain
acid solvents. These solvents are promising as battery
fluids, and as systems for metallurgical separations.
Research results have the potential of improvement
in high-energy-density batteries, corrosion prevention,
new approaches for thermal batteries, and innovations
for auxiliary power sources. This research concerns
a study of the behavior of oxides in chloroaluminate
melts. These high-valent metal oxides are candidates
for cathode materials. A study is to be made on sulfur
and sulfides in the chloroaluminate systems as they
are soluble in the acid melts. In addition, the solvent,
solute properties of low-temperature Lewis acid systems,
such as ethylpyridinium bromide--aluminum chloride
melt, will be investigated, due to its potential as
a solvent for both sulfides and oxides, high temperature
ring-disc electrodes will be used in these studies.

<>
<TITLE>Organic electrochemistry in aluminum chloride
melts 10654-C
<DURATION>07/75-06/76
<INVESTIG>Osteryoung, R.A.; Miller, L.L.
<PHONE>C(202)381-5511
<RES ORG>Colorado State Univ., Fort Collins. Dept.
of Physics
<ZIP CODE>80521
<LOCATION>CO
<SP NAME>Department of the Army, Washington, D.C.
<DESCRIPT>Electrochemical reactions of organic compounds
in low melting fused salts will be investigated. The
basic research generated by this proposal has direct
relevance to achieving fuel cell systems utilizing
hydrocarbons as fuel. It may also serve as the basis
for high power density, secondary battery systems,
and in developing low-temperature molten salt batteries.
Research will include: (1) surveying anodic reactions
of several classes of organic compounds in order to
select for further study a number of synthetically
and mechanistically important reactions; (2) investigation
of chemical electrochemical reactions of aromatic and
aliphatic hydrocarbons; (3) surveying possible cathodic
processes with particular reference to those systems
having strongly complexed substrates and to species
whose follow-up chemical reactions could have large
driving forces; and (4) investigation of possible solute-solvent
interactions in AlCl3 solvent systems and comparison
with other aprotic solvents.

<>
<TITLE>High rate stable nickel-cadmium batteries
<DURATION>07/75-06/76
<INVESTIG>McCarter, W.K.
<PHONE>C(202)381-5511
<RES ORG>Eagle-Picher Industries, Inc., Colorado Springs,
Colo.. Precision Products Dept.
<ZIP CODE>80911
<LOCATION>CO
<SP NAME>Department of the Army, Washington, D.C.
<FUNDING>73.1;0;0
<DESCRIPT>None

# CORPORATE INDEX

In the Corporate Index, report literature is indexed using the name of the organization or institution responsible for issuing the report. Headings are provided for all report literature and for published literature for which a corporate approach is especially desirable, e.g., symposium and conference proceedings.

Each entry under a corporate heading gives the report title and the citation number. Report numbers, if applicable, are given in parentheses at the end of the entry.

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A


ADVISORY GROUP FOR AEROSPACE RESEARCH AND DEVELOPMENT, 92 - NEUILLY-SUR-SEINE (FRANCE)
Space power systems. Part II, 43 (AD--698653)
AEROJET-GENERAL CORP., SACRAMENTO, CALIF. (USA). NUCLEAR DIV.
Aerolyte battery program. Summary report, December 1967--May 1968, 741 (RN-NC--0018)
AEROJET NUCLEAR SYSTEMS CO., SACRAMENTO, CALIF. (USA)
Engine electrical power source, trade study 419, 5022 (TID/SNA--581)
AERONAUTICAL SYSTEMS DIV., WRIGHT-PATTERSON AFB, OHIO (USA)
In-house battery separator investigation, 2787 (AD--430044)
AERONUTRONIC, NEWPORT BEACH, CALIF. (USA)
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Title, (supplementary information), citation number, (report number)

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The descriptors selected for use as subject terms are generally the names of specific materials, things, or processes. To the extent possible, a qualifier is selected to describe the properties of, or processses applied to, the subject term.

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| 718833 | 47 | NTIS |
| 718854 | 1786 | NTIS |
| 719099 | 4838 | NTIS |
| 720600 | 2934 | NTIS |
| 720770 | 1787 | NTIS |
| 721646 | 1788 | NTIS |
| 722384 | 396 | NTIS |
| 723978 | 1789 | NTIS |
| 725848 | 1790 | NTIS |
| 725849 | 1791 | NTIS |
| 726407 | 1792 | NTIS |
| 726607 | 397 | NTIS |
| 726607 | 2935 | NTIS, $3.00 |
| 726814 | 1793 | NTIS |
| 728431 | 2936 | NTIS |
| 728839 | 2937 | NTIS |
| 728894 | 2938 | NTIS |
| 729225 | 398 | NTIS |
| 729291 | 1794 | NTIS |
| 729923 | 399 | NTIS |
| 730867 | 2939 | NTIS |
| 732198 | 400 | NTIS |
| 732339 | 2940 | NTIS |
| 732349 | 2941 | NTIS |
| 732495 | 401 | NTIS |
| 732712 | 1795 | NTIS |
| 732830 | 2942 | NTIS |
| 733063 | 402 | NTIS |
| 733289 | 1796 | NTIS |
| 733290 | 403 | NTIS |
| 733422 | 404 | NTIS |
| 733890 | 1797 | NTIS |
| 734694 | 1798 | NTIS |
| 734809 | 4988 | See N-72-19066 |
| 734927 | 405 | NTIS |
| 735003 | 1799 | NTIS |
| 735269 | 406 | NTIS |
| 735662 | 407 | NTIS |
| 735736 | 2943 | NTIS |
| 735864 | 408 | NTIS |
| 736016 | 2944 | NTIS |
| 736460 | 2945 | NTIS |
| 736471 | 1800 | NTIS |
| 737519 | 1801 | NTIS |
| 737703 | 409 | NTIS |
| 738880 | 1802 | NTIS |
| 738907 | 1803 | NTIS |
| 739211 | 410 | NTIS |
| 739325 | 48 | NTIS |
| 739353 | 411 | NTIS |
| 739740 | 1804 | NTIS |
| 740060 | 1805 | NTIS |
| 740061 | 1806 | NTIS |
| 740105 | 1807 | NTIS |
| 740210 | 4839 | NTIS |
| 740234 | 412 | NTIS |
| 740552 | 2946 | NTIS |
| 740571 | 49 | NTIS, $3.00; $0.95 (mf) |
| 740616 | 50 | NTIS |
| 741340 | 1808 | NTIS |
| 741342 | 413 | NTIS |
| 741351 | 2947 | NTIS |
| 741704 | 1809 | NTIS |
| 741801 | 1810 | NTIS |
| 741804 | 2948 | NTIS |
| 742012 | 1811 | NTIS |
| 742219 | 2949 | NTIS |
| 742720 | 2950 | NTIS |
| 742887 | 1812 | NTIS |
| 743017 | 2951 | NTIS |
| 743214 | 414 | NTIS |
| 743769 | 2952 | NTIS |
| 744254 | 2953 | NTIS |
| 744605 | 2954 | NTIS |
| 745361 | 2955 | NTIS |
| 745571 | 2956 | NTIS |
| 745977 | 2957 | NTIS |
| 746335 | 2958 | NTIS |
| 746549 | 51 | NTIS |
| 746633 | 415 | NTIS |
| 747775 | 416 | NTIS |
| 748047 | 2959 | NTIS |
| 748109 | 2960 | NTIS |
| 748251 | 1813 | NTIS |
| 748252 | 1814 | NTIS |
| 748253 | 1815 | NTIS |
| 748434 | 417 | NTIS |
| 748454 | 418 | NTIS |
| 748455 | 1816 | NTIS |
| 748694 | 184 | NTIS, $3.00 |
| 748896 | 1817 | NTIS |
| 749270 | 2961 | NTIS |
| 749779 | 419 | NTIS |
| 750719 | 420 | NTIS |
| 750907 | 1818 | NTIS |
| 751751 | 421 | NTIS |
| 752160 | 422 | NTIS |
| 752257 | 423 | NTIS |
| 753361 | 424 | NTIS |
| 754257 | 2962 | NTIS |
| 754725 | 1819 | NTIS |
| 755550 | 425 | NTIS |
| 756431 | 426 | NTIS |
| 756557 | 2500 | NTIS, $3.00 |
| 756557 | 1820 | NTIS |
| 756955 | 1821 | NTIS |
| 757288 | 2963 | NTIS |
| 757296 | 427 | NTIS |
| 757438 | 1822 | NTIS |
| 757440 | 1823 | NTIS |
| 757535 | 428 | NTIS |
| 757883 | 2964 | NTIS |
| 758170 | 1824 | NTIS |
| 758171 | 2965 | NTIS |
| 758856 | 429 | NTIS, $3.00 |
| 758917 | 430 | NTIS |
| 758917 | 4823 | NTIS, $3.00 |
| 759754 | 2966 | NTIS |
| 759754 | 4822 | NTIS, $3.00 |
| 759812 | 3214 | See N-73-25104 |
| 761186 | 1825 | NTIS |
| 761281 | 2967 | |
| 762181 | 2968 | NTIS |
| 762573 | 431 | NTIS |
| 762602 | 1826 | NTIS |
| 763140 | 432 | NTIS, $14.50 |
| 763931 | 2783 | NTIS, $7.00 |
| 763931 | 1827 | NTIS |
| 763939 | 2969 | NTIS |
| 763939 | 4821 | NTIS, $3.00 |
| 765476 | 433 | NTIS, $4.50 |
| 767624 | 2068 | See N-74-12745 |
| 768500 | 52 | NTIS, $7.75 |
| 768500 | 697 | See N-74-14792 |
| 770533 | 1393 | See N-74-16817 |
| 770721 | 1828 | NTIS |
| 770970 | 1829 | NTIS |
| 771397 | 699 | See N-74-17798 |
| 771753 | 434 | NTIS |
| 771843 | 2079 | See N-74-17803 |
| 771961 | 700 | See N-74-17805 |
| 772072 | 2970 | NTIS |
| 772421 | 2971 | NTIS |
| 772421 | 4820 | NTIS, $4.00 |
| 772903 | 435 | NTIS |
| 772944 | 1830 | NTIS |
| 773053 | 2972 | NTIS |
| 774308 | 436 | NTIS |
| 774308 | 701 | See N-74-20708 |
| 774562 | 3218 | See N-74-20707 |
| 774674 | 2973 | |
| 774797 | 1831 | NTIS |
| 774811 | 437 | NTIS |
| 776101 | 2782 | NTIS, $3.00 |
| 776101 | 1832 | NTIS |
| 776234 | 1833 | NTIS, $3.75 $1.45 (mf) |
| 776234 | 1834 | NTIS |
| 776734 | 53 | NTIS, $3.25; $1.45 (mf) |
| 777665 | 438 | NTIS, $3.00; $1.45 (mf) |
| 777665 | 439 | NTIS |
| 777665 | 1460 | NTIS, $3.00 |
| 777857 | 440 | NTIS, $3.25; $1.45 (mf) |
| 778671 | 1835 | NTIS, $3.00; $1.45 (mf) |
| 778825 | 441 | NTIS, $3.75 |
| 778968 | 1836 | NTIS, $3.00; $1.45 (mf) |
| 779175 | 442 | NTIS, $3.00; $1.45 (mf) |
| 779385 | 2975 | NTIS |
| 780028 | 4840 | NTIS |
| 780940 | 443 | NTIS, $3.25; $1.45 (mf) |
| 781224 | 2416 | NTIS, $4.00 |
| 781224 | 444 | NTIS, $4.00; $1.45 (mf) |
| 781250 | 4819 | NTIS, $4.00 |
| 781788 | 1837 | NTIS, $6.50; $1.45 (mf) |
| 781835 | 1838 | NTIS, $6.50; $1.45 (mf) |
| 781983 | 2781 | NTIS, $4.00 |
| 782059 | 445 | NTIS, $3.25; $1.45 (mf) |
| 782241 | 2976 | NTIS, $3.25 |
| 782365 | 2977 | NTIS, $5.75; $1.45 (mf) |
| 782888 | 2978 | NTIS, $3.25 |
| 782888 | 2979 | NTIS |
| 782910 | 446 | NTIS, $5.00 |
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| 783490 | 448 | NTIS, $3.00; $2.25 (mf) |
| 783832 | 54 | NTIS, $7.00; $2.25 (mf) |
| 783853 | 2980 | NTIS, $3.00; $2.25 (mf) |

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| 784902 | 450 | NTIS, $4.00 |
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| 785970 | 4215 | NTIS, $3.25 |
| 786549 | 1840 | NTIS, $3.75 |
| 786813 | 5188 | NTIS, $3.25 |
| 787125 | 1841 | NTIS, $5.75 |
| 800315L | 2981 | DDC |
| 800799 | 451 | |
| 800981 | 1842 | |
| 801010 | 2982 | NTIS |
| 801355L | 1843 | DDC |
| 801501 | 2983 | |
| 801589 | 2984 | |
| 801655 | 1844 | |
| 801811 | 1845 | NTIS |
| 801812 | 1846 | NTIS |
| 801852 | 55 | NTIS |
| 801852 | 56 | |
| 802203 | 1847 | |
| 802208 | 452 | |
| 802279 | 453 | |
| 802355 | 454 | |
| 802386 | 1848 | |
| 802841 | 1849 | NTIS |
| 803027 | 2985 | |
| 803529 | 2986 | |
| 804103 | 455 | |
| 804558 | 456 | |
| 804559 | 2987 | |
| 804814 | 457 | |
| 805146 | 2988 | NTIS |
| 805274 | 2989 | NTIS |
| 805403 | 1850 | NTIS |
| 805413 | 2990 | |
| 805540 | 1851 | |
| 805859 | 2991 | NTIS |
| 806478 | 1852 | |
| 806812 | 2992 | NTIS |
| 806861 | 2993 | NTIS |
| 806927 | 57 | NTIS |
| 807067 | 2994 | NTIS |
| 807778 | 4621 | No. 1, vp(Jan 1965) |
| 808475 | 458 | |
| 808839 | 2995 | NTIS |
| 808937 | 2996 | NTIS |
| 809237 | 1853 | NTIS |
| 809279 | 2997 | |
| 810831 | 2998 | NTIS |
| 811343 | 459 | |
| 811439 | 1854 | NTIS |
| 812841L | 58 | DDC |
| 812898 | 2999 | NTIS |
| 813321 | 460 | |
| 813526 | 3000 | |
| 813731 | 1855 | NTIS |
| 813774 | 3001 | NTIS |
| 814002 | 1856 | NTIS |
| 814021 | 461 | |
| 814508 | 59 | NTIS |
| 814601 | 3002 | |
| 815027 | 3003 | NTIS |
| 816308 | 462 | |
| 816378 | 3004 | NTIS |
| 816527 | 3005 | |
| 816711L | 1857 | DDC |
| 818309 | 463 | |
| 818935 | 464 | |
| 819494 | 465 | |
| 819967 | 3006 | |
| 820160 | 1858 | |
| 820259 | 3007 | NTIS |
| 820273 | 3008 | |
| 820467 | 1859 | NTIS |
| 820687 | 466 | |
| 821051 | 467 | |
| 821594 | 468 | |
| 821811 | 3009 | NTIS |
| 821895 | 1860 | NTIS |
| 822335 | 3010 | |
| 822337 | 3011 | NTIS |
| 822442 | 469 | |
| 822449 | 1861 | NTIS |
| 822515 | 470 | |
| 823190 | 471 | |
| 823304 | 472 | NTIS, $3.00 |
| 823679 | 473 | |
| 824307 | 3012 | |
| 824398 | 474 | |
| 824467 | 475 | |
| 824659 | 3013 | |
| 824687 | 3014 | |
| 824719 | 3015 | |
| 825167 | 476 | |
| 825181 | 477 | |
| 825241 | 3016 | |
| 825660 | 1862 | |
| 826132 | 1863 | |
| 826328 | 3017 | |
| 826554 | 478 | |
| 827683 | 479 | |
| 828224 | 3018 | |
| 828589 | 480 | |
| 828612 | 481 | |
| 828639 | 1864 | |
| 829092 | 3019 | |
| 829093 | 3020 | |
| 829289 | 482 | |
| 829655 | 483 | |
| 830318 | 60 | |
| 830943 | 1865 | |
| 831150 | 484 | |
| 831349 | 3021 | |
| 831437 | 1866 | |
| 831452 | 485 | |
| 832005 | 486 | |
| 832025 | 1867 | |
| 832071 | 1868 | |
| 832212 | 3022 | |
| 832486 | 1869 | |
| 832535 | 1870 | |
| 832538 | 1871 | |
| 832539 | 1872 | |
| 832582 | 3023 | |
| 834213 | 1873 | |
| 834300 | 1874 | |
| 834600 | 1875 | |
| 834903 | 487 | NTIS, $3.00 |
| 834903 | 488 | |
| 834995 | 3024 | |
| 835219 | 1876 | |
| 835257 | 3025 | NTIS, $3.00 |
| 835961 | 3026 | |
| 836554 | 489 | |
| 837032 | 3027 | |
| 837084 | 1877 | |
| 837262 | 3028 | |
| 837458 | 3029 | |
| 837598 | 490 | |
| 838775 | 1878 | |
| 838988 | 1879 | |
| 839186 | 5263 | No. 1, vp(1968) |
| 839298 | 3030 | |
| 839644 | 491 | |
| 839883 | 3031 | |
| 840076 | 492 | |
| 840290 | 493 | |
| 840361 | 3032 | NTIS, $3.00 |
| 840361 | 494 | |
| 840560 | 495 | |
| 840860 | 1880 | |
| 841130 | 496 | NTIS |
| 841130 | 497 | |
| 841560 | 3033 | |
| 841829 | 3034 | |
| 842501 | 3035 | |
| 843141 | 498 | |
| 843245 | 499 | |
| 843503 | 500 | |
| 843741 | 501 | |
| 845234 | 1881 | |
| 845273 | 502 | |
| 845340 | 3036 | |
| 845341 | 1882 | |
| 845913 | 503 | |
| 845914 | 504 | |
| 846063 | 505 | |
| 846999 | 3037 | |
| 847053 | 3038 | |
| 847067 | 3039 | |
| 847080 | 506 | |
| 847137 | 507 | |
| 847223 | 3040 | |
| 847362 | 1883 | |
| 847742 | 3041 | |
| 848884 | 508 | |
| 848981 | 1884 | |
| 849009 | 509 | |
| 849523 | 3042 | |
| 849828 | 510 | |
| 849830 | 511 | |
| 850093 | 1885 | |
| 850292 | 512 | |
| 850474 | 1886 | |
| 851056 | 1887 | |
| 851418 | 1888 | |
| 851880 | 1889 | |
| 852580 | 1890 | |
| 852691 | 1891 | |
| 853037 | 513 | |
| 853250 | 3043 | |
| 853350 | 1892 | |

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|---|---|---|
| 853490 | 3044 | |
| 853881 | 1893 | |
| 853976 | 514 | |
| 854317 | 3045 | |
| 854368 | 515 | |
| 854593 | 3046 | |
| 855955L | 61 | DDC |
| 856423 | 516 | |
| 856788 | 1894 | |
| 857146 | 3047 | |
| 857173 | 3048 | |
| 857500 | 3049 | |
| 859323 | 1895 | |
| 859386 | 3050 | |
| 859690 | 1896 | |
| 859743 | 517 | |
| 860365 | 3051 | |
| 860591 | 3052 | |
| 860708 | 518 | |
| 860882 | 3053 | |
| 861077 | 3054 | |
| 861947 | 519 | |
| 862506 | 1897 | |
| 862540 | 1898 | |
| 863071 | 520 | |
| 863309 | 3055 | |
| 865063 | 521 | NTIS |
| 865063 | 522 | |
| 866147 | 3056 | |
| 866617 | 1899 | NTIS |
| 866639 | 3057 | NTIS |
| 868158 | 1900 | NTIS |
| 868159 | 3058 | NTIS |
| 868205 | 523 | |
| 868947 | 524 | |
| 869422 | 1901 | NTIS |
| 870181 | 525 | |
| 870688 | 526 | |
| 870799 | 527 | |
| 870855 | 1902 | NTIS |
| 871108 | 62 | |
| 873119 | 528 | |
| 873240 | 529 | |
| 874598 | 530 | |
| 876484 | 531 | |
| 876828 | 532 | |
| 877278 | 1903 | NTIS, $4.00 |
| 877313 | 3059 | NTIS |
| 877701 | 4841 | NTIS |
| 878215 | 3060 | |
| 878841 | 3061 | NTIS |
| 879606 | 3062 | |
| 880894 | 533 | |
| 880896 | 3063 | NTIS |
| 880899 | 1904 | NTIS |
| 881187 | 3064 | NTIS |
| 882182 | 3065 | NTIS, $5.00 |
| 882183 | 3066 | NTIS, $6.75 |
| 882890 | 3067 | |
| 882890 | 3068 | NTIS, PC A05/MF A01 |
| 883905 | 3069 | NTIS |
| 884722 | 3070 | NTIS |
| 885799 | 534 | |
| 886125L | 63 | DDC |
| 887653 | 3071 | |
| 890113 | 1905 | |
| 891776 | 3072 | |
| 894790L | 1906 | DDC |
| 894791L | 1907 | DDC |
| 894797L | 1908 | DDC |
| 894816L | 3073 | DDC |
| 894970L | 535 | DDC |
| 896566L | 3074 | DDC |
| 900475L | 536 | DDC |
| 900508L | 1909 | DDC |
| 900561L | 3075 | DDC |
| 900696L | 1910 | DDC |
| 900702L | 3076 | DDC |
| 900779L | 1911 | DDC |
| 901015L | 1912 | DDC |
| 901265L | 1913 | DDC |
| 901266L | 1914 | DDC |
| 901267L | 1915 | DDC |
| 901311L | 1916 | DDC |
| 901714L | 1917 | DDC |
| 901747L | 3077 | DDC |
| 901918L | 3078 | DDC |
| 902276L | 3079 | DDC |
| 902358L | 1918 | DDC |
| 902526L | 4842 | DDC |
| 902570L | 537 | DDC |
| 902658L | 3080 | DDC |
| 902749L | 538 | DDC |
| 902965L | 1919 | DDC |
| 903276L | 3081 | DDC |
| 903317L | 3082 | DDC |
| 903374L | 1920 | DDC |
| 903381L | 1921 | DDC |
| 903420L | 1922 | DDC |
| 903421L | 1923 | DDC |
| 903445L | 1924 | DDC |
| 903861L | 539 | DDC |
| 904366L | 1925 | DDC |
| 904367L | 1926 | DDC |
| 904404L | 1927 | DDC |
| 904428L | 1928 | DDC |
| 904429L | 1929 | DDC |
| 904700L | 1930 | DDC |
| 904851L | 3083 | DDC |
| 904964L | 3084 | DDC |
| 905118L | 1931 | DDC |
| 905126L | 4843 | DDC |
| 905408 | 3085 | NTIS |
| 905610L | 1932 | DDC |
| 905612L | 3086 | DDC |
| 905683L | 1933 | DDC |
| 905686L | 1934 | DDC |
| 905687L | 1935 | DDC |
| 905759L | 540 | DDC |
| 905944L | 1936 | DDC |
| 906063 | 3087 | NTIS |
| 906102L | 1937 | DDC |
| 906172L | 1938 | DDC |
| 906360L | 1939 | DDC |
| 906369L | 1940 | DDC |
| 906370L | 1941 | DDC |
| 906407L | 541 | DDC |
| 906599L | 542 | DDC |
| 906676L | 1942 | DDC |
| 906794L | 1943 | DDC |
| 907585L | 1944 | DDC |
| 907704 | 543 | NTIS |
| 907721L | 3088 | DDC |
| 908040L | 3089 | DDC |
| 908198 | 1945 | NTIS |
| 908198 | 1946 | NTIS, $3.50 |
| 908253L | 3090 | DDC |
| 908263L | 544 | DDC |
| 908298L | 4844 | DDC |
| 908374L | 1947 | DDC |
| 908388L | 1948 | DDC |
| 908400L | 3091 | DDC |
| 908534L | 1949 | DDC |
| 908765L | 545 | DDC |
| 908970L | 546 | DDC |
| 909005L | 4845 | DDC |
| 909331L | 3092 | DDC |
| 909450L | 547 | DDC |
| 909458L | 3093 | DDC |
| 909496L | 3094 | DDC |
| 909885L | 3095 | DDC |
| 909904L | 1950 | DDC |
| 909939L | 548 | DDC |
| 910115L | 1951 | DDC |
| 910142L | 1952 | DDC |
| 910187L | 1953 | DDC |
| 910396L | 549 | DDC |
| 910631L | 1954 | DDC |
| 910738L | 3096 | DDC |
| 910807L | 1955 | NTIS |
| 910857L | 1956 | DDC |
| 910972L | 1957 | DDC |
| 911406L | 1958 | DDC |
| 911407L | 1959 | NTIS |
| 911451 | 1960 | NTIS |
| 911451 | 1961 | NTIS, PC A03/MF A01 |
| 911460L | 3097 | DDC |
| 911508 | 3098 | NTIS |
| 911508 | 3099 | NTIS, $4.50 |
| 911579L | 4846 | DDC |
| 911812L | 1962 | DDC |
| 912002L | 4847 | DDC |
| 912153L | 1963 | DDC |
| 912262L | 1964 | DDC |
| 912458 | 3100 | NTIS |
| 912458 | 3101 | NTIS, $4.00 |
| 912664L | 1965 | DDC |
| 912804 | 550 | NTIS |
| 912804 | 551 | NTIS |
| 912989L | 1966 | DDC |
| 913104 | 552 | NTIS, $4.50 |
| 913197L | 553 | DDC |
| 913295L | 1967 | DDC |
| 913308L | 554 | DDC |
| 913488L | 3102 | DDC |
| 913676L | 1968 | DDC |
| 913912L | 1969 | DDC |
| 913957L | 3103 | DDC |
| 914149L | 555 | DDC |
| 914248 | 1970 | |
| 914248 | 3104 | NTIS, $7.75; $1.45 (mf) |
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| 914883L | 3106 | DDC |
| 915258L | 1971 | DDC |
| 915259L | 1972 | DDC |
| 915260L | 1973 | DDC |
| 915448L | 1974 | DDC |
| 915478L | 1975 | DDC |
| 915568L | 1976 | DDC |
| 915740L | 4848 | DDC |
| 915855L | 556 | DDC |
| 915890L | 1977 | DDC |
| 915962 | 65 | |
| 915962 | 557 | NTIS |
| 915962 | 558 | NTIS |
| 916042L | 1978 | DDC |
| 916361L | 1979 | |
| 916409L | 1980 | DDC |
| 916410L | 1981 | DDC |
| 916497L | 1982 | DDC |
| 916499L | 1983 | DDC |
| 916703L | 1984 | DDC |
| 916826L | 1985 | DDC |
| 917235L | 559 | DDC |
| 917329L | 1986 | DDC |
| 917330L | 1987 | DDC |
| 917331L | 1988 | DDC |
| 917332L | 1989 | DDC |
| 917455L | 1990 | DDC |
| 917525L | 560 | DDC |
| 917663L | 561 | DDC |
| 917732L | 1991 | DDC |
| 917760L | 1992 | DDC |
| 917874L | 562 | DDC |
| 917948L | 3107 | DDC |
| 918123L | 1993 | DDC |
| 918225L | 3108 | DDC |
| 918965L | 563 | DDC |
| 919015 | 66 | NTIS |
| 919015 | 67 | |
| 919148L | 1994 | DDC |
| 919263L | 1995 | DDC |
| 919452L | 3109 | DDC |
| 919478L | 4849 | DDC |
| 920346L | 4850 | DDC |
| 921643 | 1996 | |
| 922405 | 564 | |
| A032298 | 3110 | NTIS, PC A09/MF/A01 |
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| B004198 | 68 | NTIS |
| AD/A- | | |
| 000103 | 565 | NTIS, $3.25 |
| 000246 | 2415 | NTIS, $3.25 |
| 000417 | 566 | NTIS, $3.75 |
| 000845 | 567 | NTIS |
| 001218 | 1207 | NTIS, $3.25 |
| 001498 | 2414 | NTIS, $3.25 |
| 001526 | 1998 | NTIS, $4.75 |
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| 001572 | 3111 | NTIS, $3.75 |
| 001610 | 3112 | NTIS |
| 001610 | 3113 | NTIS, $4.75 |
| 002142 | 3114 | NTIS, $3.75 |
| 002566 | 568 | NTIS |
| 002701 | 569 | NTIS, $4.25 |
| 002767 | 2000 | NTIS, $3.75 |
| 002848 | 2001 | NTIS, $5.75 |
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| 005055 | 3116 | NTIS, $3.75 |
| 005055/9ST | 3117 | NTIS, PC A03/MF A01 |
| 005060 | 4285 | NTIS, $3.25 |
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| 006093 | 1183 | NTIS, $4.25 |
| 006149 | 2002 | NTIS, $3.75 |
| 006427 | 572 | NTIS, $7.50 |
| 006479 | 2003 | NTIS, $2.25 |
| 006548 | 573 | NTIS, $4.25 |
| 006548 | 574 | NTIS, $4.25 |
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| 006572 | 2005 | NTIS, $3.25 |
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| 008849 | 577 | NTIS, $3.25 |
| 009116 | 3118 | NTIS, $3.75 |
| 009145 | 3119 | NTIS, $3.75 |
| 011027 | 2006 | NTIS |
| 011227 | 2007 | NTIS, $4.25 |
| 011231 | 2008 | Availability: Available in microfiche only. |
| 011995 | 2009 | NTIS, $3.75 |
| 012303 | 2010 | NTIS, $4.75 |
| 013364 | 3120 | NTIS, $4.75 |
| 013498 | 2011 | NTIS, $3.75 |
| 013931/1ST | 3121 | NTIS, $3.75 |
| 014337 | 2012 | NTIS, $4.25 |
| 014474 | 2013 | NTIS, $3.25 |
| 014881 | 578 | NTIS, $3.75 |
| 015018 | 579 | NTIS, $3.75 |
| 015337 | 69 | NTIS, $7.25 |
| 015520 | 580 | NTIS, $5.25 |
| 016132 | 2014 | NTIS, $3.25 |
| 016643 | 581 | NTIS, $3.75 |
| 016721 | 3122 | NTIS, $3.25 |
| 016770 | 582 | NTIS, $5.75 |
| 016792 | 3123 | NTIS, $3.75 |
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| 018517 | 3127 | NTIS, $5.00 |
| 018852 | 2015 | NTIS, $4.00 |
| 019480 | 2016 | NTIS, $5.50 |
| 019511 | 2017 | Availability: Available in microfiche only. |
| 019580 | 3128 | NTIS, $4.00 |
| 020164 | 585 | NTIS, $4.50 |
| 020299 | 2018 | NTIS, $3.50 |
| 020365 | 586 | NTIS, $4.00 |
| 022199 | 3129 | NTIS, $4.00 |
| 022350 | 587 | NTIS, $6.75 |
| 022467 | 3130 | NTIS, $4.00 |
| 023437 | 2019 | NTIS, $4.00 |
| 023496 | 588 | NTIS, $6.75 |
| 024031 | 70 | NTIS, $4.00 |
| 024658 | 3131 | NTIS, $6.00 |
| 025202 | 3132 | NTIS, $4.00 |
| 026171 | 589 | NTIS, $4.00 |
| 026197 | 2020 | NTIS (US Sales Only) |
| 026359 | 590 | NTIS (US Sales Only) |
| 026551 | 3133 | NTIS, $6.00 |
| 027694 | 3134 | NTIS (US Sales Only) |
| 027770 | 2021 | NTIS, $10.75 |
| 031704 | 4851 | Dep. NTIS, PC A02/MF A01 |
| 031866 | 3135 | Dep. NTIS, PC A02/MF A01 |
| 032342 | 3136 | NTIS, PC A02/MF A01 |
| 033764 | 3137 | NTIS, PC A12/MF A01 |
| 034074 | 3138 | NTIS, PC A02/MF A01 |
| 035409 | 2022 | NTIS, PC A05/MF A01 |
| 035722 | 2023 | NTIS, PC A03/MF A01 |
| 035983 | 591 | NTIS, PC A04/MF A01 |
| 035996 | 2024 | NTIS, PC A03/MF A01 |
| 036071 | 3139 | NTIS PCA03/MF A01 |
| 036280 | 592 | NTIS PCA02/MF A01 |
| 036290 | 3140 | NTIS PCA03/MF A01 |
| 036458 | 4852 | NTIS PCA04/MF A01 |
| 037215 | 593 | NTIS, PC A02/MF A01 |
| 037216 | 594 | NTIS, PC A04/MF A01 |
| 037676 | 595 | NTIS, PC A02/MF A01 |
| 037721 | 596 | NTIS, PC A02/MF A01 |
| 037722 | 2025 | NTIS, PC A02/MF A01 |
| 038754 | 3141 | NTIS PCA03/MF A01 |
| 038915 | 2026 | NTIS PCA02/MF A01 |
| 039335 | 3142 | NTIS PCA02/MF A01 |
| 039518 | 3143 | NTIS PCA02/MF A01 |
| 039521 | 2027 | NTIS PCA02/MF A01 |
| 039735 | 3144 | NTIS PCA02/MF A01 |
| 039899 | 3145 | NTIS PCA07/MF A01 |
| 041867 | 2028 | NTIS PCA03/MF A01 |
| AD-B- | | |
| 002753 | 597 | NTIS |
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| 003275 | 3146 | NTIS, PC A02/MF A01 |
| 003476 | 3147 | NTIS, PC A04/MF A01 |
| ADB- | | |
| 003168 | 740 | See PD-18289 |
| 007328 | 601 | Dep. NTIS (US Sales Only), $5.50 |
| 008547 | 602 | Dep. NTIS (US Sales Only), $4.50 |
| ADL-C- | | |
| 69260 | 5000 | See PB-193254 |
| 74692 | 5004 | See PB-216622 |
| 74692 | 5005 | See PB-216622 |
| AED-CONF- | | |
| 76-203-006 | 2029 | Dep. NTIS (US Sales Only), $3.50 |
| 76-444-016 | 603 | Dep. NTIS (US Sales Only), PC A03/MF A01 |

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| 3443 | 4981 | See N-69-32305 |
| AERDL- | | |
| 1908 | 358 | See AD-660336 |
| AFAPL-CONF- | | |
| 66-3 | 344 | See AD-636153 |
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| AFAPL-TR- | | |
| 10 | 566 | See AD/A-000417 |
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| 74-75 | 2001 | See AD/A-002848 |
| 74-82 | 2012 | See AD-A-014337 |
| 75-34(Pt.1) | 3127 | See AD-A-018517 |
| 75-34-Pt-2 | 3126 | See AD-A-018478 |
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| 65-110 | 2861 | See AD-613692 |
| 69-0381 | 2924 | See AD-697037 |
| 69-0470 | 2925 | See AD-699589 |
| 72-0231 | 2952 | See AD-743769 |
| 72-0314 | 2957 | See AD-745977 |
| 72-0605 | 2964 | See AD-757883 |
| AFCRL-TR- | | |
| 73-0568 | 440 | See AD-777857 |
| AFFDL-TR- | | |
| 64-168-Pt-3 | 13 | See AD-469206 |
| AFML-TR- | | |
| 72-13 | 2956 | See AD-745571 |
| AFOSR-TR- | | |
| 74-0595 | 1836 | See AD-778968 |
| AGARDograph- | | |
| 123(Pt.2) | 43 | See AD-698653 |
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| 70-21 | 527 | See AD-870799 |
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| AMCA- | | |
| 70-002 | 521 | See AD-865063 |
| AMXFD-AE-T- | | |
| 50402 | 63 | See AD-886125L |
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| 75-1 | 605 | Dep. NTIS, $7.60 |
| 75-20 | 606 | Dep. NTIS, $4.00 |
| 75-36 | 607 | Dep. NTIS, $7.00 |
| 76-8 | 71 | Dep. NTIS, $12.75 |
| 76-9 | 617 | Dep. NTIS, $5.00 |
| 76-12 | 618 | Dep. NTIS, $4.50 |
| 76-35 | 619 | Dep. NTIS, $4.50 |
| 76-45(Rev.) | 620 | Dep. NTIS, $4.00 |
| 76-81 | 621 | Dep. NTIS, $4.50 |
| 76-98 | 622 | Dep. NTIS, PC A04/MF A01 |
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| 77-17 | 623 | Dep. NTIS, PC A04/MF A01 |
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| 77-24 | 2033 | Dep. NTIS, PC A04/MF A01 |
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| 6483 | 72 | |
| 6802 | 4974 | See N-64-19826 |
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| 7745 | 626 | NTIS, $3.00 |
| 7777 | 2035 | NTIS, $3.00 |
| 7777 | 533 | See AD-880894 |
| 7863 | 627 | NTIS, $3.00 |
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| 7998 | 628 | NTIS |
| 7999 | 629 | NTIS |
| 8038 | 630 | Dep. NTIS, $5.45 |
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| 8109 | 635 | Dep. NTIS, $5.45 |
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| 76-3541-1 | 636 | Dep. NTIS, PC A07/MF A01 |
| 76-3543-1 | 637 | Dep. NTIS, PC A06/MF A01 |
| 77-3542-1 | 638 | Dep. NTIS, PC A05/MF A01 |
| 77-3558-1 | 639 | Dep. NTIS, PC A07/MF A01 |
| 77-3621-1 (Vol.1) | 640 | Dep. NTIS, PC A19/MF A01 |
| 77-3624-1 | 641 | Dep. NTIS, PC A07/MF A01 |
| ANL-Trans- | | |
| 1060 | 2391 | Dep. NTIS, $3.50 |
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| 4135 | 4843 | See AD-905126L |
| APL-TG- | | |
| 1106 | 395 | See AD-716771 |
| 1176 | 408 | See AD-735864 |
| APTD- | | |
| 69-52 | 73 | NTIS, $3.00 |
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| 1126 | 642 | Dep. NTIS, $4.25 |
| 1345 | 643 | NTIS |
| 1346 | 722 | See PB-221280/1 |
| 1346 | 644 | NTIS |
| 1346 | 645 | |
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| 10 | 2081 | See N-74-26502 |
| ARF- | | |
| 90-391-E-F | 309 | See AD-499967 |
| ARL- | | |
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| AROD- | | |
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| ATD- | | |
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| BATT- | | |
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| 7344-Q2 | 2830 | See AD-478016 |
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| 7344-Q4 | 2840 | See AD-487623 |
| 8917-F | 406 | See AD-735269 |
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| 313 | 4860 | TIC |
| BM-IC- | | |
| 6068 | 4861 | TIC |
| 7881 | 2917 | See AD-680443 |
| BM-RI- | | |
| 2358 | 2036 | TIC |
| 2449 | 4862 | TIC |
| 3078 | 646 | TIC |
| 7566 | 720 | See PB-204136 |
| 8123 | 3260 | See PB-252615 |
| BM-TP- | | |
| 264 | 4863 | TIC |
| BMFT-FB-T- | | |
| 76-40 | 3164 | Dep. NTIS (US Sales Only), $5.00 |
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| 339 | 1839 | See AD-784902 |
| 401 | 2028 | See AD-A-041867 |
| 404-1 | 2004 | See AD/A-006571 |
| 404-2 | 2005 | See AD/A-006572 |
| 404-F | 575 | See AD/A-006748 |
| 405 | 576 | See AD/A-008044 |
| 405 | 588 | See AD-A-023496 |
| 405-1 | 2976 | See AD-782241 |
| 405-5 | 578 | See AD-A-014881 |
| 405-6 | 583 | See AD-A-017642 |
| 648 | 2925 | See AD-699589 |
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| CERL-PR-E- | | |
| 13 | 433 | See AD-765476 |
| CERL-TR-C- | | |
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| CM- | | |
| 1041 | 2792 | See AD-439673 |
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| 74-10101/5 | 4864 | NTIS, $20.00 |
| 74-11573 | 4865 | NTIS, $20.00 |
| 75-10618 | 3167 | NTIS |
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| | 4866 | Electric Vehicle Council, New York, NY |
| CONF-711166- | | (2. international electric vehicle symposium, Atlantic City, New Jersey, USA, 8-10 Nov 1971) |
| | 4892 | Electric Vehicle Council, New York, NY |
| CONF-720402- | | (163. national meeting on American Chemical Society, Boston, Massachusetts, USA, 9-14 Apr 1972) |
| P1 | 1371 | University Microfilms International, $4.00 |
| CONF-730848- | | (International symposium and workshop on the hydrogen economy, Ithaca, New York, USA, 19-22 Aug 1973) |
| 1 | 4921 | Dep. NTIS, $3.00 |
| CONF-740215- | | (3. international electric vehicle symposium, Washington, District of Columbia, USA, 19-20 Feb 1974) |
| 1 | 4922 | Dep. NTIS, $3.00 |
| CONF-740641- | | (Conference on advanced energy systems, Denver, Colorado, USA, 20-21 Jun 1974) |
| 1 | 82 | See LA-UR-74-918 |
| CONF-740805- | | (9. Intersociety Energy Conversion Engineering Conference, San Francisco, California, USA, 26-30 Aug 1974) |
| 4 | 748 | See SLA-74-5381 |
| 5 | 747 | See SLA-74-5363 |
| 7 | 653 | Dep. NTIS, $4.50 |
| CONF-740908- | | (9. international power sources symposium, Brighton, UK, 17-19 Sep 1974) |
| | 146 | Academic Press Inc. (1975). $54.50 |
| 1 | 746 | See SLA-73-5888 |
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| P2 | 1266 | Xerox University Microfilms |
| CONF-750123- | | (Contractors coordination meeting, Cambridge, Massachusetts, USA, 15-17 Jan 1975) |
| 1 | 654 | Dep. NTIS, $4.75 |
| CONF-7504129- | | (87. Battery Council International convention, Hollywood, Florida, USA, 8-10 Apr 1975) |
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| | 142 | Institute of Electrical and Electronics Engineers, Inc. (1975). $50.00 |
| CONF-750920- | | (11. propulsion conference of AIAA/SAE, Anaheim, California, USA, 29 Sep-1 Oct 1975) |
| 1 | 4972 | See LA-UR-75-1360 |
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| | 77 | Dep. NTIS, $9.75 |
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| 1 | 4952 | Dep. NTIS, $3.50 |
| 2 | 5026 | See UCRL-77440 |
| 3 | 3173 | Dep. NTIS, $3.50 |
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| | 71 | See ANL-76-8 |
| 1 | 3174 | Dep. NTIS, $3.50 |
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| 1 | 5027 | See UCRL-78066 |
| CONF-760416- | | (IEEE region six conference, Tucson, Arizona, USA, 7-9 Apr 1976) |
| 2 | 655 | Dep. NTIS, $3.50 |
| CONF-760469- | | (American power conference, Chicago, Illinois, USA, 20-22 Apr 1976) |
| 3 | 4953 | Dep. NTIS, $3.50 |
| CONF-760503- | | (International conference on liquid metal technology in energy production, Champion, Pennsylvania, USA, 3-6 May 1976) |
| 10 | 3175 | Dep. NTIS, $3.50 |
| CONF-760552- | | (International conference on superionic conductors, Schenectady, New York, USA, 10-12 May 1976) |
| 1 | 3165 | See BNL-21367 |
| CONF-760617- | | (27. power sources symposium, Fort Monmouth, New Jersey, USA, 21-24 Jun 1976) |
| 1 | 2113 | See SAND-75-5934 |
| 2 | 2112 | See SAND-75-5933 |
| 3 | 656 | Dep. NTIS, $4.00 |
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| | | Duesseldorf, F.R. Germany, 15 Jun 1976) |
| 1 | 2029 | See AED-CONF-76-203-006 |
| CONF-760866- | | (4. international electric vehicle symposium, Dusseldorf, F.R. Germany, 31 Aug-2 Sep 1976) |
| 2 | 657 | Dep. NTIS, $4.00 |
| 4 | 603 | See AED-Conf-76-444-016 |
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| 19 | 3191 | See LBL-5186 |
| CONF-761057- | | (Electrochemical Society meeting, Las Vegas, Nevada, USA, 17-22 Oct 1976) |
| 1 | 766 | See UCRL-78156 |
| CONF-7610115- | | (39. annual convention of the Independent Battery Manufacturers Association, Inc., Chicago, Illinois, USA, 6-8 Oct 1976) |
| | 78 | Independent Battery Manufacturers Association, Inc., Largo, FL, $15.00 |
| CONF-761178- | | (9. annual battery workshop, Greenbelt, Maryland, USA, 9-10 Nov 1976) |
| | 122 | See X-711-77-28 |
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| 29 | 2150 | Society of Automotive Engineers (1977). |
| 30 | 821 | Society of Automotive Engineers (1977). |
| 31 | 3346 | Society of Automotive Engineers (1977). |
| 39 | 822 | Society of Automotive Engineers (1977). |
| 40 | 823 | Society of Automotive Engineers (1977). |
| 58 | 5041 | Society of Automotive Engineers (1977). |
| 59 | 5042 | Society of Automotive Engineers (1977). |
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| 61 | 5044 | Society of Automotive Engineers (1977). |
| 62 | 5045 | Society of Automotive Engineers (1977). |
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| 64 | 5046 | Society of Automotive Engineers (1977). |
| CONF-770531- | | (Meeting of the Electrochemical Society, Philadelphia, Pennsylvania, USA, 8-13 May 1977) |
| 1 | 2044 | Dep. NTIS, PC A02/MF A01 |
| 4 | 3176 | Dep. NTIS, PC A02/MF A01 |
| 5 | 3177 | Dep. NTIS, PC A02/MF A01 |
| 6 | 658 | Dep. NTIS, PC A02/MF A01 |
| (Absts.) | 128 | Electrochemical Society (1977) |
| CONF-770814- | | (American Chemical Society meeting, Chicago, Illinois, USA, 29 Aug-2 Sep 1977) |
| 5 | 2045 | Dep. NTIS, PC A02/MF A01 |
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| 1 | 663 | Dep. NTIS, PC A11/MF A01 |
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| 1 | 664 | Dep. NTIS, PC A02/MF A01 |
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| 3 | 3180 | Dep. NTIS, PC A12/MF A01 |
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| 2520-1 | 3181 | Dep. NTIS, $5.00 |
| 2520-2 | 666 | Dep. NTIS, $4.50 |
| 2564-1 | 667 | Dep. NTIS, $3.50 |
| 2564-2 | 3182 | Dep. NTIS, $4.00 |
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| 453 | 2865 | See AD-618255 |
| 460 | 2875 | See AD-626229 |
| 499 | 2994 | See AD-807067 |
| 501 | 2993 | See AD-806861 |
| 526 | 59 | See AD-814508 |
| DCBRL-TN- | | |
| 66-10 | 27 | See AD-636056 |
| DDC-TAS- | | |
| 72-52-2 | 422 | See AD-752160 |
| 73-59 | 52 | See AD-768500 |
| 73-59 | 697 | See N-74-14792 |
| DECC- | | |
| 61098-003 | 3123 | See AD-A-016792 |
| DHEW/PUB/NIOSH- | | |
| 76/153 | 739 | See PB-266261 |
| DPG-DD- | | |
| 68-21 | 3074 | See AD-896566L |
| DRCL- | | |
| 369 | 2864 | See AD-617832 |
| DREO- | | |
| 549 | 2929 | See AD-709272 |
| 592 | 393 | See AD-709273 |
| 636 | 3071 | See AD-887653 |
| DREO-R- | | |
| 657 | 3087 | See AD-906063 |
| 705 | 2000 | See AD/A-002767 |
| 718 | 2009 | See AD-A-011995 |
| 728 | 3122 | See AD-A-016721 |
| 753 | 3140 | See AD-A-036290 |
| 755 | 2024 | See AD-A-035996 |
| 757 | 596 | See AD-A-037721 |
| DREO-TN- | | |
| 69-15 | 3055 | See AD-863309 |
| 71-30 | 1905 | See AD-890113 |
| 71-37 | 3072 | See AD-891776 |
| 72-22 | 3085 | See AD-905408 |
| 73-21 | 66 | See AD-919015 |
| 73-21 | 67 | See AD-919015 |
| 73-25 | 68 | See AD-B004198 |
| 74-29 | 581 | See AD-A-016643 |
| 75-24 | 3125 | See AD-A-017295 |
| 76-12 | 2020 | See AD-A-026197 |
| 76-18 | 4851 | See AD-A-031704 |
| 76-22 | 3135 | See AD-A-031866 |
| 77-3 | 2025 | See AD-A-037722 |
| 77-5 | 3144 | See AD-A-039735 |
| 77-7 | 2027 | See AD-A-039521 |
| 77-8 | 3142 | See AD-A-039335 |
| DS- | | |
| 2197 | 1621 | See AD-355102 |
| DST- | | |
| 1850S-403A-75 | 4852 | See AD-A-036458 |
| DT/SAS- | | |
| 176/73-SF/JM | 2077 | See N-74-16813 |
| 298/72-SF/JM | 2072 | See N-74-15773 |
| 533/72-SF/JM | 2076 | See N-74-16812 |
| 543/73-SF/JM | 2078 | See N-74-16814 |
| 561/74-JG/JM | 2093 | See N-76-20642 |
| 674/75-JMB/JM | 2094 | See N-76-20643 |

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|---|---|---|
| E- | | |
| 8054 | 3224 | See N-75-17807 |
| 8216 | 3231 | See N-76-17645 |
| 8304 | 2086 | See N-75-24866 |
| 8915 | 3239 | See N-77-14585 |
| ECOM- | | |
| 69-0063-F | 3113 | See AD/A-001610 |
| 74-0072-2 | 569 | See AD/A-002701 |
| 74-0072-3 | 570 | See AD/A-003309 |
| 74-0108-1 | 449 | See AD-784072 |
| 74-4235 | 448 | See AD-783490 |
| 0019-F | 414 | See AD-743214 |
| 0060-1 | 2947 | See AD-741351 |
| 0060-2 | 415 | See AD-746633 |
| 0060-3 | 543 | See AD-907704 |
| 0060-F-72 | 2068 | See N-74-12745 |
| 0070-S-73 | 556 | See AD-915855L |
| 0093-F | 401 | See AD-732495 |
| 0114-F-72 | 1830 | See AD-772944 |
| 0114-S | 425 | See AD-755550 |
| 0134-S | 405 | See AD-734927 |
| 0134-F | 1817 | See AD-748896 |
| 0146-F | 1797 | See AD-733890 |
| 0150-2 | 545 | See AD-908765L |
| 0150-F-73 | 559 | See AD-917235L |
| 0155-F-72 | 2970 | See AD-772072 |
| 0160-F | 391 | See AD-698030 |
| 0168-F | 418 | See AD-748454 |
| 0171-F | 404 | See AD-733422 |
| 0173-1 | 2934 | See AD-720600 |
| 0173-F | 2923 | See AD-696790 |
| 0173-F | 2937 | See AD-728839 |
| 0207-F-70 | 549 | See AD-910396L |
| 0209-1-71 | 3098 | See AD-911508 |
| 0209-F-71 | 3103 | See AD-913957L |
| 0223-F | 539 | See AD-903861L |
| 0227-F | 669 | NTIS |
| 0228-1 | 542 | See AD-906599L |
| 0248-F | 419 | See AD-749779 |
| 0249-1 | 412 | See AD-740234 |
| 0249-F | 421 | See AD-751751 |
| 0269-F-71 | 437 | See AD-774811 |
| 0272-F-72 | 670 | NTIS |
| 0272-F-72 | 700 | See N-74-17805 |
| 0272-S-72 | 3097 | See AD-911460L |
| 0274-F-69 | 555 | See AD-914149L |
| 0291-1 | 2950 | See AD-742720 |
| 0291-2 | 2961 | See AD-749270 |
| 0291-3 | 2965 | See AD-758171 |
| 0291-F | 2972 | See AD-773053 |
| 0312-F | 436 | See AD-774308 |
| 0312-F | 701 | See N-74-20708 |
| 0333-1 | 417 | See AD-748434 |
| 0333-2 | 1816 | See AD-748455 |
| 0333-3 | 424 | See AD-753361 |
| 0333-F-73 | 431 | See AD-762573 |
| 0406-F | 394 | See AD-714243 |
| 2559 | 1733 | See AD-614104 |
| 2637 | 2877 | See AD-627248 |
| 2640-7-71 | 1958 | See AD-911406L |
| 2640-8-71 | 553 | See AD-913197L |
| 2646 | 2876 | See AD-627216 |
| 2694 | 2880 | See AD-634100 |
| 2749 | 2882 | See AD-640053 |
| 2884 | 1755 | See AD-662737 |
| 2929 | 4834 | See AD-666773 |
| 2949 | 366 | See AD-668654 |
| 2979 | 2911 | See AD-673119 |
| 3047 | 2916 | See AD-680169 |
| 3054 | 1764 | See AD-680894 |
| 3056 | 2918 | See AD-680893 |
| 3061 | 381 | See AD-683461 |
| 3075 | 385 | See AD-687263 |
| 3104 | 384 | See AD-687260 |
| 3105 | 2921 | See AD-686285 |
| 3139 | 1767 | See AD-691710 |
| 3159 | 1769 | See AD-693865 |
| 3162 | 2922 | See AD-695610 |
| 3168 | 1771 | See AD-695626 |
| 3182 | 390 | See AD-697125 |
| 3213 | 1775 | See AD-700959 |
| 3232 | 2927 | See AD-703842 |
| 3255 | 2928 | See AD-706596 |
| 3287 | 1778 | See AD-708866 |
| 3306 | 44 | See AD-710951 |
| 3354 | 2932 | See AD-715707 |
| 3354 | 2933 | See AD-715707 |
| 3411 | 1789 | See AD-723978 |
| 3435 | 2940 | See AD-732339 |
| 3451 | 403 | See AD-733290 |
| 3452 | 4988 | See N-72-19066 |
| 3456 | 1796 | See AD-733289 |
| 3462 | 2942 | See AD-732830 |
| 3553 | 1808 | See AD-741340 |
| 3558 | 413 | See AD-741342 |
| 4058 | 426 | See AD-756431 |
| 4071 | 1945 | See AD-908198 |
| 4071 | 1946 | See AD-908198 |
| 4101 | 429 | See AD-758856 |
| 4108 | 2968 | See AD-762181 |
| 4166 | 435 | See AD-772903 |
| 4190 | 1831 | See AD-774797 |
| 4267 | 1998 | See AD/A-001526 |
| 4276 | 1999 | See AD/A-001529 |
| 4292 | 2002 | See AD/A-006149 |
| 4341 | 2011 | See AD-A-013498 |
| 4355 | 2014 | See AD-A-016132 |
| 4364 | 3124 | See AD-A-017117 |
| 4465 | 592 | See AD-A-036280 |
| 4474 | 595 | See AD-A-037676 |
| 03359-F | 1772 | See AD-697863 |
| EDR- | | |
| 4669 | 347 | See AD-639302 |
| ELCA- | | |
| 5.185 | 3081 | See AD-903276L |
| EOS- | | |
| 5370-Final | 2827 | See AD-476205 |
| EPA- | | |
| 460/3-74-013-a(Vol.1) | 5107 | Dep. NTIS, $5.75 |
| 460/3-74-013-d(Vol.4) | 5108 | Dep. NTIS, $16.00 |
| 460/3-74-020-a | 4967 | Dep. NTIS, $5.25 |
| 460/3-74-025 | 4968 | NTIS |
| EPRI- | | |
| 116 | 671 | Dep. NTIS, PC A03/MF A01 |
| 127-1 | 672 | Dep. NTIS, $4.00 |
| 128-0-0 | 673 | Dep. NTIS, $4.00 |
| 252 | 3183 | Dep. NTIS, PC A04/MF A01 |
| 255(TR1) | 3184 | Dep. NTIS, PC A04/MF A01 |
| 255(TR2) | 3185 | Dep. NTIS, PC A08/MF A01 |
| EPRI-EM- | | |
| 266 | 674 | Dep. NTIS, $8.00 |
| 271 | 3186 | Electric Power Research Inst., Palo Alto, CA |
| 375 | 675 | Dep. NTIS, PC A06/MF A01 |
| 413(6-77) | 3187 | Dep. NTIS, PC A07/MF A01 |
| 448-SR | 2046 | Dep. NTIS, PC A04/MF A01 |
| 460 | 676 | Dep. NTIS, PC A07/MF A01 |
| 494 | 3188 | Dep. NTIS, PC A05/MF A01 |
| EPRI-SR- | | |
| 33 | 730 | See PB-251490 |
| ER- | | |
| 12533 | 1660 | See AD-459150 |
| ERDA- | | |
| 31-109-38-2962 | 3184 | See EPRI-255(TR1) |
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| ERDA/NASA/1011- | | |
| 77/3 | 4971 | Dep. NTIS, PC A02/MF A01 |
| ESA-CR- | | |
| 576 | 2092 | See N-76-11560 |
| ESA-CR(P)- | | |
| 781 | 711 | See N-76-26702 |
| 783 | 2093 | See N-76-20642 |
| 784 | 2094 | See N-76-20643 |
| 832 | 2100 | See N-77-10661 |
| ESRO-CR(P)- | | |
| 323 | 2072 | See N-74-15773 |
| 324 | 2076 | See N-74-16812 |
| 326 | 2077 | See N-74-16813 |
| 330 | 2078 | See N-74-16814 |
| 656 | 3227 | See N-75-29452 |
| ESRO-SP- | | |
| 49 | 86 | See N-70-26430 |
| ESRO-TM- | | |
| 54(ESTEC) | 4978 | See N-68-18466 |
| 138/ESTEC/ | 2059 | See N-70-30138 |
| ESRO-TN- | | |
| 81 | 694 | See N-70-29061 |
| ETL- | | |

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|---|---|---|
| 0089 | 3139 | See AD-A-036071 |
| EUR-CEA-FC- | | |
| 518 | 64 | See AD-914449 |
| F- | | |
| 10 | 1858 | See AD-820160 |
| 150-1 | 328 | See AD-620178 |
| FSTC-HC- | | |
| 23-1160-72 | 1821 | See AD-756955 |
| FSTC-HT- | | |
| 23-40-68 | 5263 | See AD-839186 |
| 23-49-66 | 5305 | See AD-630856 |
| 23-76-74 | 54 | See AD-783832 |
| 23-135-74 | 2781 | See AD-781983 |
| 23-138-73 | 2783 | See AD-763931 |
| 23-138-73 | 1827 | See AD-763931 |
| 23-141-74 | 1207 | See AD/A-001218 |
| 23-173-75 | 4352 | See AD/A-005978 |
| 23-195-71 | 434 | See AD-771753 |
| 23-228-72 | 51 | See AD-746549 |
| 23-490-72 | 398 | See AD-729225 |
| 23-625-72 | 4846 | See AD-911579L |
| 23-630-74 | 2414 | See AD/A-001498 |
| 23-631-72 | 2955 | See AD-745361 |
| 23-631-74 | 2415 | See AD/A-000246 |
| 23-683-72 | 535 | See AD-894970L |
| 23-684-72 | 3078 | See AD-901918L |
| 23-685-72 | 2782 | See AD-776101 |
| 23-685-72 | 1832 | See AD-776101 |
| 23-686-72 | 2959 | See AD-748047 |
| 23-750-72 | 184 | See AD-748694 |
| 23-750-72 | 184 | See AD-748694 |
| 23-757-72 | 4842 | See AD-902526L |
| 23-762-72 | 548 | See AD-909939L |
| 23-823-72 | 2962 | See AD-754257 |
| 23-924-72 | 2960 | See AD-748109 |
| 23-930-74 | 1183 | See AD/A-006093 |
| 23-0119-74 | 4819 | See AD-781250 |
| 23-0343-74 | 4304 | NTIS, $4.00 |
| 23-0999-74 | 4285 | See AD/A-005060 |
| 23-1000-74 | 4286 | See AD/A-006079 |
| 23-1002-74 | 2389 | See AD/A-005065 |
| 23-1014-73 | 1393 | See N-74-16817 |
| 23-1048-71 | 1811 | See AD-742012 |
| 23-1099-72 | 3080 | See AD-902658L |
| 23-1176-72 | 4822 | See AD-759754 |
| 23-1176-72 | 2966 | See AD-759754 |
| 23-1177-72 | 1828 | See AD-770721 |
| 23-1178-72 | 3095 | See AD-909885L |
| 23-1179-72 | 3094 | See AD-909496L |
| 23-1181-72 | 3096 | See AD-910738L |
| 23-1222-72 | 4845 | See AD-909005L |
| 23-1301-72 | 3088 | See AD-907721L |
| 23-1318-73 | 4849 | See AD-919478L |
| 23-1433-72 | 3214 | See N-73-25104 |
| 23-1440-71 | 4850 | See AD-920346L |
| 23-1506-72 | 3089 | See AD-908040L |
| 23-1516-72 | 4821 | See AD-763939 |
| 23-1516-72 | 2969 | See AD-763939 |
| 23-1517-72 | 2971 | See AD-772421 |
| 23-1563-71 | 1812 | See AD-742887 |
| 23-1612-72 | 544 | See AD-908263L |
| 23-1758-72 | 2500 | See AD-756557 |
| 23-1758-72 | 1820 | See AD-756557 |
| 23-1760-72 | 1829 | See AD-770970 |
| 23-1763-72 | 1964 | See AD-912262L |
| 23-1764-72 | 3092 | See AD-909331L |
| 23-1858-73 | 2416 | See AD-781224 |
| 23-1858-73 | 444 | See AD-781224 |
| 23-1978-72 | 430 | See AD-758917 |
| 23-1978-72 | 4823 | See AD-758917 |
| 23-2105-72 | 3106 | See AD-914883L |
| 23-2241-72 | 3091 | See AD-908400L |
| 23-2242-72 | 4848 | See AD-915740L |
| 23-2360-72 | 4847 | See AD-912002L |
| FTD-HC- | | |
| 23-1723-72 | 1966 | See AD-912989L |
| 23-1728-72 | 4844 | See AD-908298L |
| 23-1813-71 | 2953 | See AD-744254 |
| FTD-HT- | | |
| 23-413-70 | 45 | See AD-713047 |
| 23-644-68 | 1447 | See AD-694885 |
| 23-0012-74 | 442 | See AD-779175 |
| 23-1570-71 | 410 | See AD-739211 |
| 23-1587-72 | 1819 | See AD-754725 |
| 66-519 | 57 | See AD-806927 |
| FTD-MT- | | |
| 24-2-74 | 53 | See AD-776734 |
| 24-400-74 | 438 | See AD-777665 |
| 24-400-74 | 439 | See AD-777665 |
| 24-400-74 | 1460 | See AD-777665 |
| 65-485 | 4689 | See AD-655021 |
| FTD-TT- | | |
| 65-185 | 4617 | See AD-620123 |
| 65-779 | 1523 | See AD-470357 |
| 65-809 | 2566 | See AD-622423 |
| 65-1879 | 5422 | See AD-639489 |
| 66-7 | 217 | See AD-638888 |
| G- | | |
| 220(Vol.1) | 1640 | See AD-441993 |
| 220-(Vol.1) | 4826 | See AD-441993 |
| GDC-BGY66- | | |
| 007 | 2021 | See AD-A-027770 |
| GDC-ERR-AN- | | |
| 1220 | 61 | See AD-855955L |
| GEPP- | | |
| 226 | 81 | Dep. NTIS, $3.50 |
| 299 | 3189 | Dep. NTIS, PC A02/MF A01 |
| 324 | 3190 | Dep. NTIS, PC A03/MF A01 |
| HAC-P- | | |
| 74_181 | 2017 | See AD-A-019511 |
| HAC-Ref-C- | | |
| 5104 | 2017 | See AD-A-019511 |
| HDL- | | |
| 065-4 | 2941 | See AD-732349 |
| HDL-TM- | | |
| 74-2 | 4840 | See AD-780028 |
| HDL-TR- | | |
| 1354 | 468 | See AD-821594 |
| 1473 | 1899 | See AD-866617 |
| 1579 | 2949 | See AD-742219 |
| 1605 | 3082 | See AD-903317L |
| IDA/HQ- | | |
| 65-3299 | 17 | See AD-482433 |
| 68-8703 | 1762 | See AD-675936 |
| IDA/HQ65- | | |
| 3299 | 16 | See AD-482433 |
| IDEP- | | |
| 562-00-00-00E1-01 | 1643 | See AD-448157 |
| IITRI-C- | | |
| 6142-5 | 582 | See AD-A-016770 |
| ISU-ERI-AMES- | | |
| 96700 | 3111 | See AD/A-001572 |
| JPL-TM- | | |
| 33-789 | 3235 | See N-76-28648 |
| LA- | | |
| 6632-MS | 678 | Dep. NTIS, $3.50 |
| LA-UR- | | |
| 74-918 | 82 | Dep. NTIS, $4.00 |
| 75-1360 | 4972 | Dep. NTIS, $4.00 |
| LBL- | | |
| 5186 | 3191 | Dep. NTIS, $3.50 |
| 6301 | 4973 | Dep. NTIS, PC A07/MF A01 |
| LMSC- | | |
| 406067C | 2983 | See AD-801501 |
| 920142 | 1711 | See AD-488954 |
| 926053 | 1842 | See AD-800981 |
| D309658 | 3083 | See AD-904851L |
| D354240 | 554 | See AD-913308L |
| LMSC-A- | | |
| 764444 | 1698 | See AD-480240 |
| LMSC-D- | | |
| 356295 | 441 | See AD-778825 |
| 464335 | 3128 | See AD-A-019580 |
| LMSC-LS- | | |
| 66-10 | 19 | See AD-485587 |
| LMSC/M- | | |
| 89-66-2 | 298 | See AD-489624 |
| LMSD- | | |
| 1182 | 2984 | See AD-801589 |

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| 1290 | 1844 | See AD-801655 |
| 1754 | 1847 | See AD-802203 |
| 1816 | 1848 | See AD-802386 |
| 445616 | 83 | |
| 505260 | 2985 | See AD-803027 |
| LTIRF- | | |
| 345/SE | 2957 | See AD-745977 |
| M- | | |
| 89-65-1 | 2822 | See AD-474219 |
| 1578 | 1719 | See AD-492038 |
| MAB- | | |
| 241 | 3023 | See AD-832582 |
| 248 | 3037 | See AD-846999 |
| MC- | | |
| 461-0003B | 257 | See AD-435366 |
| 461-0003C | 269 | See AD-458178 |
| 4610007 | 267 | See AD-457647 |
| MCR- | | |
| 76-263 | 3236 | See N-76-32651 |
| 76-321 | 713 | See N-77-20557 |
| MEC- | | |
| 10-73 | 699 | See N-74-17798 |
| MEL- | | |
| 25/65 | 2804 | See AD-462426 |
| 50/65 | 2812 | See AD-467988 |
| 61/501 | 2786 | See AD-428945 |
| 93/66 | 2878 | See AD-631951 |
| 183/66 | 2881 | See AD-638603 |
| 283/64 | 1666 | See AD-462251 |
| MEWD- | | |
| 1129 | 98 | See NP-11716 |
| MTP- | | |
| 6-3-517 | 4838 | See AD-719099 |
| N- | | |
| 63-11677 | 84 | NTIS |
| 63-14123 | 85 | PSC Publications Committee, PO Box 891, Red Bank, NJ |
| 64-19826 | 4974 | NTIS |
| 64-28373 | 4975 | AIAA, $1.00 |
| 65-18935 | 680 | NTIS, $6.00 |
| 65-36781 | 681 | NTIS, $6.00 |
| 65-36782 | 682 | NTIS, $6.00 |
| 66-15787 | 683 | NTIS, $6.00 |
| 66-23780 | 2051 | NTIS, $6.00 |
| 66-26772 | 4977 | NTIS |
| 66-31896 | 2052 | NTIS, $3.00 |
| 66-35218 | 2053 | NTIS, $6.00 |
| 67-26364 | 2054 | NTIS, $6.00 |
| 67-27639 | 1795 | See AD-732712 |
| 68-11839 | 3192 | NTIS, $3.00 |
| 68-16346 | 3193 | NTIS, $3.00 |
| 68-18466 | 4978 | NTIS, $3.00 |
| 68-19128 | 4979 | GPO, $0.20 |
| 68-21038 | 684 | NTIS |
| 68-23941 | 3194 | NTIS |
| 68-27645 | 3195 | NTIS, $3.00 |
| 68-27684 | 685 | NTIS, $3.00 |
| 68-28554 | 3196 | NTIS, $6.00 |
| 68-28714 | 30 | See AD-671685 |
| 68-28714 | 4980 | NTIS, $3.00 |
| 69-12309 | 3197 | NTIS, $6.00 |
| 69-13030 | 686 | NTIS, $6.00 |
| 69-16975 | 687 | NTIS |
| 69-19806 | 3198 | NTIS |
| 69-25396 | 688 | NTIS, $6.00 |
| 69-25397 | 689 | NTIS, $3.00 |
| 69-29708 | 3199 | NTIS, $6.00 |
| 69-32305 | 4981 | NTIS |
| 69-34689 | 4982 | NTIS |
| 69-36048 | 3200 | NTIS, $6.00 |
| 69-36829 | 690 | NTIS, $6.00 |
| 69-37830 | 2055 | NTIS, PC A07/MF A01 |
| 69-38275 | 2056 | NTIS, PC A07/MF A01 |
| 69-38423 | 3201 | NTIS, PC A07/MF A01 |
| 69-39395 | 3202 | NTIS, PC A07/MF A01 |
| 69-39418 | 2057 | NTIS, PC A07/MF A01 |
| 69-40063 | 3203 | NTIS, $6.00 |
| 69-40742 | 3204 | NTIS, PC A07/MF A01 |
| 69-40923 | 3205 | NTIS, PC A07/MF A01 |
| 69-40947 | 2058 | NTIS, PC A07/MF A01 |
| 70-10779 | 3206 | NTIS, $6.00 |
| 70-11022 | 691 | NTIS, $6.00 |
| 70-16227 | 4983 | NTIS |
| 70-16379 | 3207 | NTIS, $6.00 |
| 70-17675 | 3208 | NTIS, PC A07/MF A01 |
| 70-18977 | 692 | NTIS, PC A07/MF A01 |
| 70-24832 | 4984 | CFSTI |
| 70-25303 | 693 | NTIS, $3.00 |
| 70-25705 | 3209 | NTIS, $3.00 |
| 70-26430 | 86 | NTIS, PC A02/MF A01 |
| 70-28473 | 3210 | NTIS, PC A02/MF A01 |
| 70-29061 | 694 | NTIS, PC A02/MF A01 |
| 70-30138 | 2059 | NTIS, PC A02/MF A01 |
| 70--32647 | 3211 | NTIS, $3.00 |
| 70-34014 | 695 | NTIS, PC A02/MF A01 |
| 70-35576 | 3212 | NTIS, PC A02/MF A01 |
| 70-38614 | 2060 | NTIS, PC A03/A01 |
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| Rept-04 | 2077 | See N-74-16813 |
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| Rept-40M22410 | 2087 | See N-75-25290 |
| Rept-732-015-1 | 2066 | See N-74-10078 |
| Rept-752-015 | 2091 | See N-75-33493 |
| Rept-6738 | 3232 | See N-76-18352 |
| RM-3298-FF | 4832 | See AD-615883 |
| RN-NC-0018 | 741 | Dep. NTIS, $7.00 |
| RP-P-412 | 1762 | See AD-675936 |
| RT-TR-72-10 | 3079 | See AD-902276L |
| S-67-1183 | 475 | See AD-824467 |
| S-68-1028 | 480 | See AD-828589 |
| S-68-1128 | 491 | See AD-839644 |
| S-70-1025 | 3056 | See AD-866147 |
| SAE-TP-720040 | 742 | |
| SAM-TR-72-2 | 407 | See AD-735662 |
| SAM-TR-73-48 | 1990 | See AD-917455L |
| SAMSO-TR-74-17 | 3218 | See N-74-20707 |
| SAMSO-TR-74-163 | 2980 | See AD-783853 |
| SAND-74-0007 | 743 | Dep. NTIS, $4.25 |
| SAND-74-0041 | 744 | Dep. NTIS, $4.25 |
| SAND-75-0454 | 2108 | Dep. NTIS, $4.50 |
| SAND-75-0536 | 2109 | Dep. NTIS, $4.50 |
| SAND-75-0645 | 2110 | Dep. NTIS, $5.00 |
| SAND-75-0646 | 2111 | Dep. NTIS, PC A03/MF A01 |
| SAND-75-5933 | 2112 | Dep. NTIS, $3.50 |
| SAND-75-5934 | 2113 | Dep. NTIS, $3.50 |
| SAND-77-0411 | 3264 | Dep. NTIS, PC A03/MF A01 |
| SAND-77-6008 | 3300 | Dep. NTIS, PC A02/MF A01 |
| SAND-77-6009 | 3303 | Dep. NTIS, PC A02/MF A01 |
| SAPR-12 | 688 | See N-69-25396 |
| SAPR-13 | 689 | See N-69-25397 |
| SB-60-5 | 12 | See AD-462695 |
| SC-DR-69-398 | 3265 | Dep. NTIS, $5.28 |
| SCG-20308R | 537 | See AD-902570L |
| SCG-50124 | 2010 | See AD-A-012303 |
| SCIENTIFIC-2 | 2924 | See AD-697037 |
| SCR-154-2A | 1622 | See AD-357497 |
| SLA-73-0412A | 745 | Dep. NTIS, $4.00 |
| SLA-73-5888 | 746 | Dep. NTIS, $4.50 |
| SLA-74-5363 | 747 | Dep. NTIS, $4.00 |
| SLA-74-5381 | 748 | Dep. NTIS, $4.00 |
| SLSR-3-72B | 1818 | See AD-750907 |
| SMUFD-TM-227 | 63 | See AD-886125L |
| SPEC-CP-223545A-1 | 1845 | See AD-801811 |
| SPEC-CP-223545A-2 | 1846 | See AD-801812 |
| SRD-74-034 | 3219 | See N-74-26498 |
| SRI-EGU-4064 | 5013 | See PB-262512 |
| SRI-PYU-2285 | 3220 | See N-74-26511 |
| SRL-TR-71-0018-Rev | 411 | See AD-739353 |
| SRL-TR-71-0019 | 400 | See AD-732198 |
| SRL-TR-72-0013 | 416 | See AD-747775 |
| STUDY-S-208 | 16 | See AD-482433 |
| SU-SEL-67-028(Pt.1) | 1864 | See AD-828639 |
| T-2-3269-12 | 1850 | See AD-805403 |
| TACOM-TR-10547 | 1900 | See AD-868158 |
| TACOM-TR-10863 | 3058 | See AD-868159 |
| TACOM-TR-11849 | 560 | See AD-917525L |
| TC-6452 | 584 | See AD-A-018106 |
| TDCK-52578 | 4841 | See AD-877701 |
| TDR-930(2701-01) TN-1 | 24 | See AD-609098 |
| TEC-75-006a | 5015 | Dep. NTIS, $5.45 |
| TEC-75/006b | 5016 | Dep. NTIS, $7.60 |
| TEC-75/006c | 5018 | Dep. NTIS, $10.60 |
| TG-857 | 1744 | See AD-646903 |
| TG-942 | 1754 | See AD-661215 |
| TID-26731 | 749 | Dep. NTIS, $7.75 |
| TID-26751 | 750 | Dep. NTIS, $7.75 |
| TID-26756 | 751 | Dep. NTIS, $6.50 |
| TID-27055 | 752 | Dep. NTIS, $4.00 |
| TID-27211 | 753 | Dep. NTIS, $3.50 |
| TID/SNA-581 | 5022 | Dep. NTIS, $4.25 |
| TIL-T-5697 | 4621 | See AD-807778 |
| TM-65-33 | 1735 | See AD-622405 |
| TO-B-67-43 | 466 | See AD-820687 |
| TO-B-68-16 | 483 | See AD-829655 |
| TO-B-68-31 | 492 | See AD-840076 |
| TOP-1-1-004 | 1824 | See AD-758170 |
| TOR-0059(6769-01)-2(Vol.1) | 5002 | See PB-201645 |
| TR-72-845.2 | 415 | See AD-746633 |
| TR-72-845.3 | 543 | See AD-907704 |
| TR-73-845-1 | 2068 | See N-74-12745 |
| TR-0074(4270-10)-3 | 3218 | See N-74-20707 |
| TR-0075(5270-10)-1 | 2980 | See AD-783853 |
| TR-0077(2270- | 3143 | See AD-A-039518 |

| Report No. | Abstract No. | Availability |
|---|---|---|
| 10)-2 | | |
| 65172 | 1696 | See AD-478910 |
| TRW- | | |
| 20078-6002-RU-00 | 3254 | See PB-238691 |
| 23323-6015-RU-00 | 436 | See AD-774308 |
| 23323-6015-RU-00 | 701 | See N-74-20708 |
| 24118-6001-RU-00 | 3216 | See N-74-16808 |
| 24118-6002-RU-00 | 3223 | See N-75-15164 |
| 24118-6003-RU-00 | 2088 | See N-75-27566 |
| 26619-6013-RU-00 | 585 | See AD-A-020164 |
| U- | | |
| 3134 | 2814 | See AD-468770 |
| UCID- | | |
| 16751 | 754 | Dep. NTIS, $6.50 |
| 17098(Vol.1) | 5023 | Dep. NTIS, $4.50 |
| 17425 | 755 | Dep. NTIS, PC A02/MF A01 |
| 17426-76-3 | 3267 | Dep. NTIS, PC A02/MF A01 |
| 17426-76-4 | 3268 | Dep. NTIS, PC A02/MF A01 |
| 17426-76-5 | 756 | Dep. NTIS, PC A02/MF A01 |
| 17426-76-6 | 757 | Dep. NTIS, PC A02/MF A01 |
| 17426-76-7 | 758 | Dep. NTIS, PC A02/MF A01 |
| 17426-76-8 | 759 | Dep. NTIS, PC A02/MF A01 |
| 17426-76-10 | 3269 | Dep. NTIS, PC A02/MF A01 |
| 17426-77-2 | 760 | Dep. NTIS, PC A02/MF A01 |
| 17426-77-3 | 761 | Dep. NTIS, PC A02/MF A01 |
| 17426-77-4 | 762 | Dep. NTIS, PC A02/MF A01 |
| 17426-77-5.6.7 | 763 | Dep. NTIS, PC A02/MF A01 |
| 17457 | 3270 | Dep. NTIS, PC A03/MF A01 |
| UCLA- | | |
| 69-68 | 2926 | See AD-702938 |
| ENG-7064 | 2931 | See AD-714680 |
| UCLA-Eng- | | |
| 7078 | 396 | See AD-722384 |
| 7211 | 2948 | See AD-741804 |
| 7228 | 1912 | See AD-901015L |
| 7347 | 3100 | See AD-912458 |
| 7347 | 3101 | See AD-912458 |
| 7633 | 70 | See AD-A-024031 |
| 7634 | 3133 | See AD-A-026551 |
| 76127 | 2022 | See AD-A-035409 |
| UCRL- | | |
| 50038-76-2 | 121 | Dep. NTIS, $4.00 |
| 51811 | 764 | Dep. NTIS, $4.00 |
| 52000-75-9 | 5025 | Dep. NTIS, $4.00 |
| 52000-76-8 | 765 | Dep. NTIS, $3.50 |
| 77440 | 5026 | Dep. NTIS, $4.50 |
| 78066 | 5027 | Dep. NTIS, $3.50 |
| 78156 | 766 | Dep. NTIS, $3.50 |
| UM- | | |
| 72-10 | 420 | See AD-750719 |
| UNC- | | |
| 100 | 119 | See PB-240132 |
| USAACEBD-CE- | | |
| 1770 | 1995 | See AD-919263L |
| USAAMRDL-TR- | | |
| 74-81 | 3117 | See AD/A-005055/9ST |
| USAAVLABS-TN- | | |
| 6 | 1903 | See AD-877278 |
| USAEPG-FR- | | |
| 623 | 563 | See AD-918965L |
| USAMC-ITC- | | |
| 02-08-73-213 | 2003 | See AD/A-006479 |
| USAMERDC- | | |
| 1963 | 4836 | See AD-699351 |
| 1981 | 2930 | See AD-710249 |
| WQEC/C- | | |
| 74-337 | 2082 | See N-74-31530 |
| 75-164 | 2089 | See N-75-30652 |
| 76-5 | 2096 | See N-76-26687 |
| 76-8 | 2097 | See N-76-26688 |
| 76-89 | 2098 | See N-76-26693 |
| X- | | |
| 711-74-348 | 91 | See N-75-16976 |
| 711-75-135 | 3230 | See N-75-33497 |
| 711-75-197 | 2090 | See N-75-32588 |
| 711-75-316 | 93 | See N-76-19549 |
| 711-77-28 | 122 | Goddard Space Flight Center, |
| 761-73-183 | 2067 | See N-74-12741 |
| 761-73-314 | 3215 | See N-74-15744 |
| YPG- | | |
| 0175 | 1969 | See AD-913912L |
| ZfK- | | |
| 292 | 3273 | Dep. NTIS (US Sales Only), PC A02/MF A01 |
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Information regarding subscription purchase will be sent on request.
Foreign requesters should address inquiries to the above address.

Dep. DOE reports so designated are maintained in the organizations listed on the inside front cover.

EM Inquiries regarding the availability of blueline prints of DOE engineering drawings which were formerly available for sale by NTIS should be addressed to Technical Information Center, P. O. Box 62, Oak Ridge, Tennessee 37830.

GJO Available from DOE Grand Junction Office, P. O. Box 2567, Grand Junction, Colorado 81501.

GPO For sale by the Superintendent of Documents, Government Printing Office, Washington, D. C. 20402.

LMEC Available *only to requesters within the United States* from the Liquid Metal Engineering Center, P. O. Box 1449, Canoga Park, California 91304.

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Issue 4

October 1977

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| | | | | | |
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| A01 | $3.00 | E01 | $3.25 | T01 | $110.00 |
| A02 | 4.00 | E02 | 4.75 | T02 | 125.00 |
| A03 | 4.50 | E03 | 6.25 | T03 | 175.00 |
| A04 | 5.25 | E04 | 7.50 | T04 | 250.00 |
| A05 | 6.00 | E05 | 9.00 | T05 | 300.00 |
| A06 | 6.50 | E06 | 10.50 | T06 | 350.00 |
| A07 | 7.25 | E07 | 12.50 | T07 | 400.00 |
| A08 | 8.00 | E08 | 15.00 | T08 | 450.00 |
| A09 | 9.00 | E09 | 17.50 | T09 | 500.00 |
| A10 | 9.25 | E10 | 20.00 | T10 | 550.00 |
| A11 | 9.50 | E11 | 22.50 | T11 | 600.00 |
| A12 | 10.75 | E12 | 25.00 | T12 | 650.00 |
| A13 | 11.00 | E13 | 28.00 | T13 | 675.00 |
| A14 | 11.75 | E14 | 31.00 | T14 | 750.00 |
| A15 | 12.00 | E15 | 34.00 | T15 | 800.00 |
| A16 | 12.50 | E16 | 37.00 | T16 | 850.00 |
| A17 | 13.00 | E17 | 40.00 | T17 | 900.00 |
| A18 | 13.25 | E18 | 45.00 | T18 | 950.00 |
| A19 | 14.00 | E19 | 50.00 | T19 | 1,000.00 |
| A20 | 14.50 | E20 | 60.00 | T99 | * |
| A21 | 15.00 | E99 | * | | |
| A22 | 15.25 | | | | |
| A23 | 15.50 | N01 | 28.00 | | |
| A24 | 16.25 | N02 | 50.00 | | |
| A25 | 16.50 | | | | |
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